



## VALUE INVESTING USING F SCORE: A STUDY ON INDIAN LEADING AUTOMOBILE COMPANIES

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### Abstract

*Intrinsic Value represents the Market of a Firm which depends on several factors like Earnings per Share, Debt Equity ratio, Cost of Equity ( $K_E$ ) Cost of Capital (WACC) etc. Moreover, EPS have an impact on a Firm's Market Value. During several decades diverse capital market anomalies have been established that stood the test of time and independent scrutiny. Professor Joseph Piotroski's F Score is a discrete score between 0-9 which plays a significant role in assessing the financial strength in terms of Profitability, Leverage & Liquidity and Operating Efficiency. It is used to determine the best value stocks, with 9 being the best and 0 being the worst. Every criterion when met one point is awarded; otherwise, no points are awarded. The points are then added up to determine the best value stocks. This paper focuses on analyzing the Profitability, Leverage & Liquidity and Operating Efficiency ratios as well as the impact of Operating Cash Flow/Total Assets, Leverage, MV/BV, Return on Equity and Piotroski F Score on P/E ratio of Indian Leading Automobile Companies.*

**Keywords:** Return on Assets, Operating Cash Flow, Operating CF/TA, Debt Asset Ratio, Current Ratio, Operating Margin, Asset Turnover, Piotroski F Score, Return on Equity,  $MV_E / BV_E$ , P/E ratio.

### I. Objective of the Study

1. To analyze the Profitability, Leverage, Rate of Return, Liquidity and Operating Efficiency Ratios of leading Indian Automobile Companies as well as calculate F Score.
2. To show the change in F Score over the years from 2014 to 2019.
3. To highlight the impact of Operating Cash Flow/Total Assets, Leverage, MV/BV, ROE and Piotroski's F Score on P/E ratio of Automobile Companies.

### Review of Literature

A number of researchers in finance and accounting have extensively researched on F Score and its impact on Market Return. These have motivated the corporate to identify and improve upon their financial performance. A brief review of some of these studies has been presented.

**Jegadeesh and Titman's (2001)** study affirms that buying winning stocks and selling losing stocks based on their past performance provides abnormal returns and this zero cost momentum strategy provides abnormal returns.

**Sehgal and Balakrishnan (2002)** report continuation of trend in short term and significant high returns of value investing strategy in Indian market from July 1989 to March 1999 for 364 companies.

**Fama and French (2012)** have added momentum as a fourth factor to their three factor model to explain the excess return. Academic literature on value investing has grown leaps and bounds around the momentum strategies.

**Fama & French, 1993; Pontiff & Lawrence (1998)** believed that the stock with high market to book value is often financially distressed and thus the larger returns generated by the stock is simply a compensation for risk.

**After Basu (1977, 1983) and Rosenberg, Reid and Lanstein (1985)** conducted early research on the systematic outperformance of value stocks over growth stocks, the explanation for this return difference has been the topic of discussions among academics and practitioners alike.

**Ou and Penman (1989)** similarly showed the array of financial ratios created from historical Financial Statements have the power to predict a firm's future earnings.



**Lev B, Thiagarajan (1993)** analyzed 12 financial ratios and demonstrated their positive effect on future earnings growth. They showed that fundamental signals are correlated with contemporaneous returns after considering Current Earnings, firm size and macro variable factors.

## II. Scope of Study

The financial statement is a mirror, which reflects the financial position and operational strength and weakness of concern. But a mere look at the financial statement will not reveal some crucial information. To bring out the hidden information, financial statements over a period are analyzed.

This study is concerned with the analysis of Profitability, Leverage & Liquidity and Efficiency ratios of the Leading Indian Automobile Firms as well as impact of Operating CF/ TA, Asset Turnover, Leverage, Current Ratio, Operating Margin & F Score on P/E ratio.

**Period of Study:** The study covers a period of 6 years from 2014 to 2019.

## Methodology

### Sources of Data

The study is based on secondary data. Information and data has been collected from Annual Reports of Ashok Leyland, Bajaj, Hero Motor, Mahindra & Mahindra, Maruti Suzuki, Tata Motors and different books, journal, magazines, and various websites.

## III. Tools Applied

In this study various tools: Financial Tools – Ratio Analysis and Statistical Tools (i.e.) Mean and ANOVA, t-test has been used for data analysis.

**MEAN = Sum of variable/N**

**Standard Deviation** is used to see how measurements for a group are spread out from Mean. A low Standard Deviation means that most of the numbers are very close to the average and vice-versa.  $(SD) = \sqrt{\frac{\sum X^2}{N} - (\frac{\sum X}{N})^2}$

**Coefficient of Variation** is a standardized measure of dispersion of a probability distribution or frequency distribution. It is the ratio of standard deviation to mean. Higher the coefficient of variation, the greater the level of dispersion around mean and vice-versa.

**Coefficient of Variation (COV) = SD/MEAN\* 100**

**t-Test (Two-Sample Assuming Unequal Variances):** t-test assesses whether the means of two groups are statistically different from each other.

## Hypothesis

An ANOVA is statistical hypothesis in which the sampling distribution of test statistic when null hypotheses is true. Null hypotheses have been set and adopted for the analysis of data. The null hypotheses are represented by  $H_0$ . It is a negative statement which avoids personal bias of investigator during data collection as well as the time of drawing conclusion.

## IV. Limitation of the Study

1. The study is related to a period of 6 years.
2. Data is secondary i.e. they are collected from the published Annual Reports.
3. Profitability, Leverage & Liquidity and Efficiency ratios have been considered for this study.

## Indian Automobile Sector & Its Key Players

Indian Automobile Sector holds a strong position in terms of manufacturing of tractor, bus, heavy vehicles and passenger cars. It currently manufactures 25 mn vehicles, of which 3.5 mn are exported. Increase in income, standard of living has been the key factor behind the sale of passenger cars & two wheelers. During 2019, Automobile exports increased by 14.5% and sale of passenger cars by 2.7% & two-wheeler by 4.86%.



**Ashok Leyland:** Founded in 1948, headquartered in Chennai, Ashok Leyland is a leading automobile company. It is the 2nd largest manufacturer of commercial vehicles in India & 4th largest manufacturer of buses in the world & 12th largest manufacturer of trucks globally.

**Bajaj Auto Limited:** It was established by Jamnalal Bajaj in Rajasthan during 1940's. It manufactures both two-wheeler & three-wheeler and is the largest exporter of two and three-wheelers.

**Hero MotoCorp:** It is the world's largest manufacturer of two-wheelers. It has 4 manufacturing facilities in Dharuhera and Gurgaon in Haryana, Haridwar in Uttarakhand & Neemrana in Rajasthan.

**Mahindra & Mahindra** established in 1945, is an Indian multinational car manufacturer headquartered in Mumbai. It operates in 9 segments: automotive segment comprises of sales of automobiles spare parts and related services.

**Maruti Suzuki** is the largest passenger car company accounting for over 50% of the Indian market. It is a 56.21% owned subsidiary of Suzuki Motor Corporation.

**Tata Motors** headquartered in Mumbai is an Indian multinational automotive manufacturing company. It is a leading global automobile manufacturer of cars, utility vehicles, buses, trucks and defence vehicles. It has a strong global network and operates in UK, South Korea, Thailand, South Africa & Indonesia.

### Preface

Though investments in Emerging Market are an important destination for investors still Investors face challenge while investing in market deep value stocks. Investment Valuation by applying F Score is limited to trading in market space. F Score can be used to measure the financial strength of a portfolio in terms of Return & Liquidity, analysis of a particular stock, effect of management decision on financial health of a firm. F score calculation is based on 9 criteria divided into 3 groups namely Profitability, Leverage, Liquidity and Source of Funds & Operating Efficiency.

### 1. Profitability

Return on Assets (PAT / Total Assets)

Operating Cash Flow

Accruals (Operating CF/ Total Assets)

**Revenue:** It is the income a business generates from its Operating Activities, after deducting Sales Returns and Indirect Taxes. It plays a pivotal role behind the success and growth of an enterprise.

### Exhibit – 1: Revenue

Millions	Ashok Leyland	Bajaj	Hero Motor	Mahindra & Mahindra	Maruti	Tata Motors
2014	1,18,592	2,01,583	2,52,755	7,40,009	4,43,963	23,28,337
2015	1,57,082	2,16,143	2,75,380	7,14,480	5,08,014	26,31,590
2016	2,17,279	2,25,865	2,84,571	7,58,414	5,75,890	27,30,456
2017	2,32,654	2,17,667	2,86,104	8,37,731	6,80,850	26,96,925
2018	3,00,533	2,52,189	3,24,584	9,20,940	7,98,094	29,15,505
2019	3,36,207	3,02,500	3,39,708	10,47,207	8,60,685	30,19,384
<b>Mean</b>	2,27,058	2,35,991	2,93,850	8,36,463	6,44,583	27,20,366
<b>SD</b>	82,584	36,611	32,322	1,27,926	1,64,438	2,40,712
<b>COV</b>	0.364	0.155	0.110	0.153	0.255	0.088
<b>CAGR (%)</b>	23.2	8.5	6.1	7.2	14.2	5.3

Tata Motors reported the highest mean value in terms of Revenue followed by Mahindra & Mahindra & Maruti. Ashok Leyland reported the maximum CAGR of 23.2% followed by Maruti, indicating the maximum growth in Revenue.

**Hypothesis:**

**H<sub>0</sub>:**  $\mu_1=\mu_2=\mu_3=\mu_4=\mu_5=\mu_6$  (Revenue of Automobile Companies doesn't differ over years)

**H<sub>1</sub>:**  $\mu_1 \mu_2 \mu_3 \mu_4 \mu_5 \mu_6$  (Revenue of Automobile Companies differ over years)

**Exhibit – 2: Revenue: Automobile Companies: Anova**

**ANOVA: Single Factor**

**ANOVA: Single Factor**

Groups	Count	Sum	Average	Variance
<b>ASHOK LEYLAND</b>	6	1362345	227057.5333	6820078328
<b>BAJAJ</b>	6	1415947	235991.0833	1340391857
<b>HERO MOTOR</b>	6	1763102	293850.4	1044716064
<b>MAHINDRA &amp; MAHINDRA</b>	6	5018780	836463.3833	16365123712
<b>MARUTI</b>	6	3867496	644582.6667	27039840245
<b>TATA MOTORS</b>	6	16322197	2720366.1	57942076712

**ANOVA: Variation**

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2.767E+13	5	5.534E+12	300.3469	1.15E-24	2.53355
Within Groups	5.52761E+11	30	18425371153			
<b>Total</b>	2.82228E+13	35				

Above analysis shows that the F value (300.3469) is more than the table value (2.53355) so, null hypothesis is rejected. Therefore it is concluded that Revenue of Automobile Companies differs over the years.

**Net Income** indicates the Profit After Tax ie, the amount of Profit available for Equity Share holders.

**Exhibit – 3: Net Income (PAT)**

Millions	Ashok Leyland	Bajaj	Hero Motor	Mahindra & Mahindra	Maruti	Tata Motors
2014	-2,317	32,344	21,059	43,234	28,316	1,41,042
2015	-2,140	28,119	23,485	25,927	37,906	1,40,597
2016	7,122	40,612	31,123	35,545	54,972	1,11,007
2017	16,329	40,795	35,463	40,505	75,110	60,636
2018	18,138	42,189	37,222	79,578	78,807	68,131
2019	21,946	49,276	34,664	60,169	76,506	-2,89,337
<b>Mean</b>	9,846	38,889	30,503	47,493	58,603	38,679
<b>SD</b>	10,547	7,539	6,721	19,313	21,726	1,64,342
<b>COV</b>	1.071	0.194	0.220	0.407	0.371	4.249
<b>CAGR (%)</b>	-256.8	8.8	10.5	6.8	22.0	-215.5

Maruti has the highest mean in terms of PAT followed by Mahindra & Mahindra & Bajaj. Maruti reported the maximum CAGR of 22%. Tata Motors reported a Loss for 2018-19 which have reduced their Mean Value and reported a Negative CAGR.

**Hypothesis:**

**H<sub>0</sub>:**  $\mu_1=\mu_2=\mu_3=\mu_4=\mu_5=\mu_6$  (Net Income of Automobile Companies doesn't differ over years)

**H<sub>1</sub>:**  $\mu_1 \mu_2 \mu_3 \mu_4 \mu_5 \mu_6$  (Net Income of Automobile Companies differ over years)

**Exhibit – 4: Net Income (PAT): Automobile Companies: Anova**

**ANOVA: Single Factor**

Groups	Count	Sum	Average	Variance
ASHOK LEYLAND	6	59078.2	9846.37	111244196.4
BAJAJ	6	233335.6	38889.27	56842902.99
HERO MOTOR	6	183015.5	30502.58	45174191
MAHINDRA & MAHINDRA	6	284957.3	47492.88	372986706.1
MARUTI	6	351617	58602.83	472010482.6
TATA MOTORS	6	232075.1	38679.18	27008139398
ASHOK LEYLAND	6	59078.2	9846.37	111244196.4

**ANOVA: Variation**

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	8172196684	5	1634439337	0.34941	0.878542	2.53355
Within Groups	1.4033E+11	30	4677732979			
<b>Total</b>	<b>1.48504E+11</b>	<b>35</b>				

Above analysis shows that the F value (0.34941) is less than the table value (2.53355) so, null hypothesis is accepted.

An **Asset** is a present economic resource controlled by the entity as a result of past events from which it can generate future benefits in terms of Revenue. Total Assets include both Non Current Assets (Tangible & Intangible) and Current Assets.

**Exhibit – 5: Total Assets**

Millions	Ashok Leyland	Bajaj	Hero Motor	Mahindra & Mahindra	Maruti	Tata Motors
2014	1,75,343	1,53,078	1,01,216	8,82,703	3,15,802	21,99,983
2015	1,91,746	1,65,146	1,08,683	9,48,440	3,45,831	23,86,580
2016	2,21,987	1,72,404	1,28,958	10,06,321	4,33,577	26,92,976
2017	2,66,683	2,16,376	1,53,120	11,47,422	5,19,605	27,37,544
2018	3,35,180	2,51,410	1,73,967	13,72,109	6,02,484	33,13,505
2019	3,91,220	2,88,344	1,85,044	16,33,916	6,39,687	30,71,945
<b>Mean</b>	<b>2,63,693</b>	<b>2,07,793</b>	<b>1,41,831</b>	<b>11,65,152</b>	<b>4,76,164</b>	<b>27,33,756</b>
<b>SD</b>	<b>84,975</b>	<b>53,906</b>	<b>34,472</b>	<b>2,88,047</b>	<b>1,33,492</b>	<b>4,14,150</b>
<b>COV</b>	<b>0.322</b>	<b>0.259</b>	<b>0.243</b>	<b>0.247</b>	<b>0.280</b>	<b>0.151</b>
<b>CAGR (%)</b>	<b>17.4</b>	<b>13.5</b>	<b>12.8</b>	<b>13.1</b>	<b>15.2</b>	<b>6.9</b>

Above Exhibit depicts that Tata Motors has the highest mean in terms of Total Assets followed by Mahindra & Mahindra & Maruti. Ashok Leyland has the maximum CAGR of 17.4% followed by Maruti, indicating the maximum growth in Total Assets.

**Hypothesis:**

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$  (Total Assets of Automobile Companies doesn't differ over years)

$H_1: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq \mu_6$  (Total Assets of Automobile Companies differ over years)

**Exhibit – 6: Total Assets: Automobile Companies: Anova**

**ANOVA: Single Factor**

Groups	Count	Sum	Average	Variance
ASHOK LEYLAND	6	1582159	263693.2113	7220768868
BAJAJ	6	1246758	207792.95	2905905871
HERO MOTOR	6	850988.2	141831.3667	1188316302
MAHINDRA & MAHINDRA	6	6990910	1165151.583	82970841918
MARUTI	6	2856986	476164.3333	17819989782
TATA MOTORS	6	16402533	2733755.517	1.71521E+11
ASHOK LEYLAND	6	1582159	263693.2113	7220768868

**ANOVA: Variation**

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	3.02593E+13	5	6.05186E+12	128.02470	2.69E-19	2.53355
Within Groups	1.41813E+12	30	47271071201			
<b>Total</b>	<b>3.16775E+13</b>	<b>35</b>				

Above analysis shows that the F value (128.0247) is more than the table value (2.53355) so, null hypothesis is rejected. Therefore it is concluded that Total Assets of Automobile Companies differs over the years.

**Return on Assets** measures the quality of the Assets owned and shows how profitable a company's assets is in generating its revenues. Higher the ratio, it indicates that a company is utilizing its Assets effectively.

**Exhibit – 7: Return On Assets (%)**

Year	Ashok Leyland	Bajaj	Hero Motor	Mahindra & Mahindra	Maruti	Tata Motors
2014	-1.32	21.13	20.81	4.90	8.97	6.41
2015	-1.12	17.03	21.61	2.73	10.96	5.89
2016	3.21	23.56	24.13	3.53	12.68	4.12
2017	6.12	18.85	23.16	3.53	14.46	2.21
2018	5.41	16.78	21.40	5.80	13.08	2.06
2019	5.61	17.09	18.73	3.68	11.96	-9.42
<b>Mean</b>	<b>2.99</b>	<b>19.07</b>	<b>21.64</b>	<b>4.03</b>	<b>12.02</b>	<b>1.88</b>
<b>SD</b>	<b>3.41</b>	<b>2.75</b>	<b>1.88</b>	<b>1.11</b>	<b>1.89</b>	<b>5.82</b>
<b>COV</b>	<b>1.141</b>	<b>0.144</b>	<b>0.087</b>	<b>0.276</b>	<b>0.158</b>	<b>3.097</b>
<b>CAGR (%)</b>	<b>-233.53</b>	<b>-4.16</b>	<b>-2.08</b>	<b>-5.54</b>	<b>5.93</b>	<b>-208</b>

Hero Motor reported the highest mean value in terms of Return on Assets followed by Bajaj Auto & Maruti. All other Automobile companies reported a negative CAGR except Maruti which had a CAGR of 5.63%.

**Hypothesis:**

**H<sub>0</sub>:**  $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$  (Return on Assets of Automobile Companies doesn't differ over years)

**H<sub>1</sub>:**  $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq \mu_6$  (Return on Assets of Automobile Companies differ over years)

### Exhibit – 8: Return On Assets (%): Automobile Companies: Anova

#### ANOVA: Single Factor

Groups	Count	Sum	Average	Variance
ASHOK LEYLAND	6	17.915	2.986	11.607
BAJAJ	6	114.437	19.073	7.551
HERO MOTOR	6	129.838	21.640	3.548
MAHINDRA & AHINDRA	6	24.176	4.029	1.237
MARUTI	6	72.101	12.017	3.588
TATA MOTORS	6	11.277	1.879	33.890
ASHOK LEYLAND	6	17.915	2.986	11.607

#### ANOVA: Variation

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	2233.2930	5	446.659	43.6328	7.08E-13	2.53355
Within Groups	307.1029	30	10.237			
<b>Total</b>	<b>2540.3959</b>	<b>35</b>				

Above analysis shows that the F value (43.6328) is more than the table value (2.53355) so, null hypothesis is rejected. Therefore it is concluded that Return on Total Assets of Automobile Companies differs over the years.

**Operating Cash Flow** is the Cash generated by a business from its Operating Activities during a financial period. It indicates whether a company have sufficient amount of Cash to maintain and grow its operations.

### Exhibit – 9: Operating Cash Flows

Millions	Ashok Leyland	Bajaj	Hero Motor	Mahindra & Mahindra	Maruti	Tata Motors
2014	-1,040.0	35,017.1	29,630.2	-2,437.4	49,946.0	3,61,511.6
2015	950.7	21,138.0	21,855.1	10,548.6	64,492.0	3,55,312.6
2016	-12,746.7	36,898.5	37,223.7	23,847.6	84,825.0	3,78,995.4
2017	2,701.0	32,673.6	40,071.9	1,830.9	1,02,820.0	3,01,992.5
2018	14,624.3	43,278.4	40,172.1	6,818.6	1,17,879.0	2,38,574.2
2019	-37,454.9	24,868.6	10,322.7	-43,472.9	66,009.0	1,88,907.5
<b>Mean</b>	<b>-5,494.3</b>	<b>32,312.4</b>	<b>29,879.3</b>	<b>-477.4</b>	<b>80,995.2</b>	<b>3,04,215.6</b>
<b>SD</b>	<b>17,929.7</b>	<b>8,111.8</b>	<b>11,922.1</b>	<b>22,909.8</b>	<b>25,738.7</b>	<b>76,283.0</b>
<b>COV</b>	<b>-3.263</b>	<b>0.251</b>	<b>0.399</b>	<b>-47.985</b>	<b>0.318</b>	<b>0.251</b>
<b>CAGR (%)</b>	<b>104.78</b>	<b>-6.62</b>	<b>-19.01</b>	<b>77.93</b>	<b>5.74</b>	<b>-12</b>

Tata Motors has the highest mean in terms of Operating Cash Flows followed by Maruti & Bajaj Auto. Mahindra & Mahindra reported the maximum CAGR of 77.93% followed by Maruti, indicating the maximum growth in Operating Cash Flows.

#### Hypothesis:

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$  (Operating Cash Flows of Automobile Companies doesn't differ over years)

$H_1: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq \mu_6$  (Operating Cash Flows of Automobile Companies differ over years)

### Exhibit – 10: Operating Cash Flows: Anova

#### ANOVA: Single Factor

Groups	Count	Sum	Average	Variance
ASHOK LEYLAND	6	-32965.6	-5494.271333	321475224.4
BAJAJ	6	193874.2	32312.36667	65801742.11
HERO MOTOR	6	179275.7	29879.28333	142136295.6
MAHINDRA & MAHINDRA	6	-2864.6	-477.4333333	524858557.2
MARUTI	6	485971	80995.16667	662479717.4
TATA MOTORS	6	1825294	304215.6333	5819089401
ASHOK LEYLAND	6	-32965.6	-5494.271333	321475224.4

#### ANOVA: Variation

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	4.1159E+11	5	82317352407	65.5407	3.11E-15	2.53355
Within Groups	37679204690	30	1255973490			
<b>Total</b>	<b>4.4927E+11</b>	<b>35</b>				

Above analysis shows that the F value (65.5407) is more than the table value (2.53355) so, null hypothesis is rejected. Therefore it is concluded that Operating Cash Flows of Automobile Companies differs over the years

**Operating Cash Flow on Total Assets** is an efficiency ratio which rates the cash flows of company assets without being affected by income measurements. It is calculated by dividing Operating Cash Flows by Total Assets.

### Exhibit – 11: Operating Cash Flows / Total Assets (%)

Year	Ashok Leyland	Bajaj	Hero Motor	Mahindra & Mahindra	Maruti	Tata Motors
2014	-0.59	22.88	29.27	-0.28	15.82	16.43
2015	0.50	12.80	20.11	1.11	18.65	14.89
2016	-5.74	21.40	28.86	2.37	19.56	14.07
2017	1.01	15.10	26.17	0.16	19.79	11.03
2018	4.36	17.21	23.09	0.50	19.57	7.20
2019	-9.57	8.62	5.58	-2.66	10.32	6.15
<b>Mean</b>	<b>-1.67</b>	<b>16.34</b>	<b>22.18</b>	<b>0.20</b>	<b>17.28</b>	<b>11.63</b>
<b>SD</b>	<b>5.07</b>	<b>5.34</b>	<b>8.85</b>	<b>1.68</b>	<b>3.72</b>	<b>4.23</b>
<b>COV</b>	<b>-3.030</b>	<b>0.327</b>	<b>0.399</b>	<b>8.367</b>	<b>0.215</b>	<b>0.364</b>
<b>CAGR (%)</b>	<b>74.42</b>	<b>-17.72</b>	<b>-28.22</b>	<b>57.32</b>	<b>-8.19</b>	<b>-17.85</b>

Hero Motor has the highest mean in terms of Operating Cash Flows/TA followed by Maruti & Bajaj Auto. Mahindra & Mahindra reported the maximum CAGR of 57.32%

#### Hypothesis

**H<sub>0</sub>:**  $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$  (Operating Cash Flows / Total Assets of Automobile Companies doesn't differ over years)

**H<sub>1</sub>:**  $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq \mu_6$  (Operating Cash Flows / Total Assets of Automobile Companies differ over years)



### Exhibit – 12: Operating Cash Flows / Total Assets: Anova

#### ANOVA: Single Factor

Groups	Count	Sum	Average	Variance
ASHOK LEYLAND	6	-10.0374	-1.672893	25.699874
BAJAJ	6	98.01661	16.336102	28.540322
HERO MOTOR	6	133.0887	22.181456	78.333839
MAHINDRA & MAHINDRA	6	1.201709	0.200285	2.807988
MARUTI	6	103.7006	17.283430	13.840776
TATA MOTORS	6	69.7749	11.629150	17.933519
ASHOK LEYLAND	6	-10.0374	-1.672893	25.699874

#### ANOVA: Variation

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2823.6721	5	564.7344	20.27089	8.24E-09	2.53355
Within Groups	835.7816	30	27.8594			
<b>Total</b>	<b>3659.4537</b>	<b>35</b>				

Above analysis shows that the F value (20.27089) is more than the table value (2.53355) so, null hypothesis is rejected. Therefore it is concluded that Operating Cash Flows / Total Assets of Automobile Companies differs over the years

## 2. Leverage, Liquidity & Source of Funds

Long-term Debt/ Total Assets

Current Ratio

Shares Outstanding

**Long-term Debt** represents the Debt acquired by an organization to finance its Long Term as well as Short Term operations. High amount of Debt increases Interest as well as Bankruptcy Cost.

### Exhibit – 13: Long Term Debt

Millions	Ashok Leyland	Bajaj	Hero Motor	Mahindra & Mahindra	Maruti	Tata Motors
2014	86,363.1	2,678.5	3,587.3	2,54,917.5	24,646.0	7,58,500.8
2015	92,500.2	2,523.8	1,975.8	2,23,270.3	10,813.0	9,83,199.2
2016	1,14,732.7	2,361.6	3,000.1	2,35,987.8	10,676.0	9,55,141.0
2017	1,34,516.5	2,545.6	3,362.3	3,01,245.1	16,264.0	11,68,637.5
2018	1,63,450.3	2,809.2	3,470.7	3,38,091.8	17,493.0	11,43,283.0
2019	1,98,859.1	1,841.5	4,324.4	4,35,261.7	22,538.0	13,52,681.7
<b>Mean</b>	<b>1,31,737.0</b>	<b>2,460.0</b>	<b>3,286.8</b>	<b>2,98,129.0</b>	<b>17,071.7</b>	<b>10,60,240.5</b>
<b>SD</b>	<b>43,373.5</b>	<b>338.6</b>	<b>775.5</b>	<b>79,680.2</b>	<b>5,799.3</b>	<b>2,06,007.7</b>
<b>COV</b>	<b>0.329</b>	<b>0.138</b>	<b>0.236</b>	<b>0.267</b>	<b>0.340</b>	<b>0.194</b>
<b>CAGR (%)</b>	<b>18.15</b>	<b>-7.22</b>	<b>3.81</b>	<b>11.29</b>	<b>-1.77</b>	<b>12.27</b>

Tata Motors has the highest mean in terms of Long Term Debt followed by Mahindra & Mahindra & Ashok Leyland. Bajaj Auto & Maruti reported a Negative CAGR indicating that its Debt Capital has fallen over the years.

#### Hypothesis:

**H<sub>0</sub>:**  $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$  (Long-Term Debt of Automobile Companies doesn't differ over years)

**H<sub>1</sub>:**  $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq \mu_6$  (Long-Term Debt of Automobile Companies differ over years)

### Exhibit – 14: Long Term Debt: Anova

#### ANOVA: Single Factor

Groups	Count	Sum	Average	Variance
ASHOK LEYLAND	6	790421.9	131737	1881259764
BAJAJ	6	14760.2	2460.033	114661.0987
HERO MOTOR	6	19720.6	3286.767	601470.2707
MAHINDRA & MAHINDRA	6	1788774	298129	6348940062
MARUTI	6	102430	17071.67	33631326.67
TATA MOTORS	6	6361443	1060241	42439187047
ASHOK LEYLAND	6	790421.9	131737	1881259764

#### ANOVA: VARIATION

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	5.09498E+12	5	1.02E+12	120.5824	6.30E-19	2.53355
Within Groups	2.53519E+11	30	8.45E+09			
<b>Total</b>	<b>5.3485E+12</b>	<b>35</b>				

Above analysis shows that the F value (120.5824) is more than the table value (2.53355) so, null hypothesis is rejected. Therefore it is concluded that Operating Long-Term Debt of Automobile Companies differs over the years

**Debt Asset Ratio:** It measures the Long Term Debt of a company as a percentage of Total Assets. A high Debt / Asset ratio indicates high amount of Interest expenses which has to be paid irrespective of the amount of profit earned.

### Exhibit – 15: Long Term Debt / Total Assets

Year	Ashok Leyland	Bajaj	Hero Motor	Mahindra & Mahindra	Maruti	Tata Motors
2014	0.493	0.017	0.035	0.289	0.078	0.345
2015	0.482	0.015	0.018	0.235	0.031	0.412
2016	0.517	0.014	0.023	0.235	0.025	0.355
2017	0.504	0.012	0.022	0.263	0.031	0.427
2018	0.488	0.011	0.020	0.246	0.029	0.345
2019	0.508	0.006	0.023	0.266	0.035	0.440
<b>Mean</b>	<b>0.50</b>	<b>0.01</b>	<b>0.02</b>	<b>0.26</b>	<b>0.04</b>	<b>0.39</b>
<b>SD</b>	<b>0.013</b>	<b>0.004</b>	<b>0.006</b>	<b>0.021</b>	<b>0.020</b>	<b>0.044</b>
<b>COV</b>	<b>0.027</b>	<b>0.304</b>	<b>0.257</b>	<b>0.082</b>	<b>0.518</b>	<b>0.113</b>
<b>CAGR (%)</b>	<b>0.63</b>	<b>-18.26</b>	<b>-7.99</b>	<b>-1.60</b>	<b>-14.71</b>	<b>5.01</b>

Bajaj Auto has the lowest mean value indicating the Minimum amount of Debt wrt Total Assets followed by Hero Motor & Maruti. Bajaj, Hero Motor, Mahindra & Mahindra & Maruti all reported a Negative CAGR depicting the fall in Debt/Asset ratio over the years.

#### Hypothesis:

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$  (Long-Term Debt / Total Assets of Automobile Companies doesn't differ over years)

$H_1: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq \mu_6$  (Long-Term Debt / Total Assets of Automobile Companies differ over years)

**Exhibit – 16: Long Term Debt / Total Assets: Anova**

**ANOVA: Single Factor**

Groups	Count	Sum	Average	Variance
ASHOK LEYLAND	6	2.992152	0.4986920	0.000176
BAJAJ	6	0.075803	0.0126338	0.000015
HERO MOTOR	6	0.142164	0.0236940	0.000037
MAHINDRA & MAHINDRA	6	1.534041	0.2556735	0.000441
MARUTI	6	0.229501	0.0382501	0.000392
TATA MOTORS	6	2.323688	0.3872814	0.001929
ASHOK LEYLAND	6	2.992152	0.4986920	0.000176

**ANOVA: VARIATION**

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.31820	5	0.26364	529.0368	2.7E-28	2.53355
Within Groups	0.01495	30	0.00050			
<b>Total</b>	<b>1.33315</b>	<b>35</b>				

Above analysis shows that the F value (529.0368) is more than the table value (2.53355) so, null hypothesis is rejected. Therefore it is concluded that Operating Long-Term Debt / Total Assets of Automobile Companies differs over the years

**Current Ratio:** It measures the Liquidity of a firm and plays a significant role in management of Working Capital.

**Exhibit – 17: Current Ratio**

Year	Ashok Leyland	Bajaj	Hero Motor	Mahindra & Mahindra	Maruti	Tata Motors
2014	1.95	0.84	0.70	3.09	0.97	1.36
2015	2.02	0.93	0.99	3.18	0.75	1.23
2016	2.85	1.36	1.07	3.28	0.78	1.15
2017	2.68	1.16	0.89	3.26	0.64	1.20
2018	2.41	0.97	0.89	3.17	0.55	1.23
2019	3.03	1.18	1.42	2.95	0.65	1.33
<b>Mean</b>	<b>2.49</b>	<b>1.07</b>	<b>0.99</b>	<b>3.15</b>	<b>0.72</b>	<b>1.25</b>
<b>SD</b>	<b>0.44</b>	<b>0.19</b>	<b>0.24</b>	<b>0.12</b>	<b>0.15</b>	<b>0.08</b>
<b>COV</b>	<b>0.178</b>	<b>0.180</b>	<b>0.243</b>	<b>0.038</b>	<b>0.203</b>	<b>0.063</b>
<b>CAGR (%)</b>	<b>9.25</b>	<b>7.14</b>	<b>14.98</b>	<b>-0.89</b>	<b>-7.66</b>	<b>-0.51</b>

Mahindra & Mahindra reported the maximum mean value in terms of Current Ratio followed by Ashok Leyland & Tata Motors. Hero Motor reported the maximum CAGR of 14.98% indicating the maximum growth in Current Ratio over the period.

**Hypothesis:**

**H<sub>0</sub>:**  $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$  (Current Ratio of Automobile Companies doesn't differ over years)

**H<sub>1</sub>:**  $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq \mu_6$  (Current Ratio of Automobile Companies differ over years)

### Exhibit – 18: Current Ratio: Anova

#### ANOVA: Single Factor

Groups	Count	Sum	Average	Variance
ASHOK LEYLAND	6	14.9293	2.4882	0.1967
BAJAJ	6	6.4382	1.0730	0.0373
HERO MOTOR	6	5.9502	0.9917	0.0580
MAHINDRA & MAHINDRA	6	18.9295	3.1549	0.0146
MARUTI	6	4.3416	0.7236	0.0215
TATA MOTORS	6	7.5005	1.2501	0.0063
ASHOK LEYLAND	6	14.9293	2.4882	0.1967

#### ANOVA: VARIATION

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	28.463207	5	5.692641	102.1673	6.585E-18	2.53355
Within Groups	1.671565	30	0.055719			
<b>Total</b>	<b>30.134772</b>	<b>35</b>				

Above analysis shows that the F value (102.1673) is more than the table value (2.53355) so, null hypothesis is rejected. Therefore it is concluded that Current Ratio of Automobile Companies differs over the years

**Shares Outstanding:** It depicts the total number of shares issued by the companies which are fully paid up.

### Exhibit – 19: Shares Outstanding (Millions)

Year	Ashok Leyland	Bajaj	Hero Motor	Mahindra & Mahindra	Maruti	Tata Motors
2014	2,660.68	289.37	199.69	591.39	302.08	3,219.40
2015	2,845.88	289.37	199.69	591.39	302.08	3,219.40
2016	2,845.88	289.37	199.69	541.78	302.08	2,887.35
2017	2,845.88	289.37	199.70	541.78	302.08	2,887.35
2018	2,935.50	289.37	199.71	1,243.19	302.08	2,887.35
2019	2,927.10	289.37	199.73	1,243.19	302.08	2,887.35
<b>Mean</b>	<b>2,843.49</b>	<b>289.37</b>	<b>199.7</b>	<b>792.12</b>	<b>302.08</b>	<b>2,998.03</b>
<b>SD</b>	<b>98.89</b>	<b>0</b>	<b>0.02</b>	<b>350.1</b>	<b>0</b>	<b>171.47</b>
<b>COV</b>	<b>0.035</b>	<b>0</b>	<b>0.00008</b>	<b>0.442</b>	<b>0</b>	<b>0.057</b>
<b>CAGR (%)</b>	<b>1.93</b>	<b>0</b>	<b>0</b>	<b>16.02</b>	<b>0</b>	<b>-2.15</b>

Above Exhibit depicts that there have been no change in the number of Eq Shares of Bajaj, Hero Motor & Maruti. For Tata Motors there has been a buy back during FY 2015-16.

### 3. Operating Efficiency

Operating Margin

Asset Turnover

**Operating Margin:** It is an important margin ratio which indicates the Operating Profit (PBIT) as a percentage of Net Revenue.

### Exhibit – 20: Operating Margin %

Year	Ashok Leyland	Bajaj	Hero Motor	Mahindra & Mahindra	Maruti	Tata Motors
2014	8.73	23.10	11.38	11.86	8.41	10.14
2015	8.98	18.92	12.52	10.45	9.80	10.09
2016	12.23	25.15	15.47	13.18	13.17	6.96

2017	14.83	25.68	17.17	17.08	14.87	5.03
2018	14.77	23.53	16.40	15.54	13.99	5.43
2019	15.02	23.01	15.13	13.27	12.34	-8.48
<b>Mean</b>	12.43	23.23	14.68	13.56	12.10	4.86
<b>SD</b>	2.95	2.383	2.26	2.41	2.51	6.90
<b>COV</b>	0.238	0.103	0.15398	0.178	0.207	1.419
<b>CAGR (%)</b>	11.46	-0.076	5.87	2.27	7.98	-196.49

Bajaj reported the maximum mean value in terms of Operating Margin followed by Hero Motor, Mahindra & Mahindra & Ashok Leyland. Tata Motors Operating Margin has been negative during FY 2018-19 indicating Loss suffered by the Company.

### Hypothesis:

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$  (Operating Margin of Automobile Companies doesn't differ over years)

$H_1: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq \mu_6$  (Operating Margin of Automobile Companies differ over years)

### Exhibit – 21: Operating Margin: Anova

#### ANOVA: Single Factor

Groups	Count	Sum	Average	Variance
<b>ASHOK LEYLAND</b>	6	74.560122	12.426687	8.713502
<b>BAJAJ</b>	6	139.381152	23.230192	5.679363
<b>HERO MOTOR</b>	6	88.073195	14.678866	5.108885
<b>MAHINDRA &amp; MAHINDRA</b>	6	81.386237	13.564373	5.825621
<b>MARUTI</b>	6	72.585296	12.097549	6.281882
<b>TATA MOTORS</b>	6	29.176681	4.862780	47.625278
<b>ASHOK LEYLAND</b>	6	74.560122	12.426687	8.713502

#### ANOVA: VARIATION

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1042.7262	5	208.5452	15.79200	1.247E-07	2.53355
Within Groups	396.1727	30	13.2058			
<b>Total</b>	1438.8988	35				

Above analysis shows that the F value (15.79200) is more than the table value (2.53355) so, null hypothesis is rejected. Therefore it is concluded that Operating Margin of Automobile Companies differs over the years

**Asset Turnover:** It is an important turnover ratio which reflects the quality of the Assets and its impact on Revenue generation. A high turnover indicates that the organization have been able to utilize its Assets effectively & efficiently.

### Exhibit – 22: Asset Turnover

Year	Ashok Leyland	Bajaj	Hero Motor	Mahindra & Mahindra	Maruti	Tata Motors
2014	0.71	1.32	2.50	0.84	1.41	1.06
2015	0.87	1.31	2.53	0.75	1.47	1.10
2016	1.03	1.31	2.21	0.75	1.33	1.01
2017	0.92	1.01	1.87	0.73	1.31	0.99
2018	0.91	1.00	1.87	0.67	1.32	0.88

2019	0.86	1.05	1.84	0.64	1.35	0.98
<b>Mean</b>	0.88	1.17	2.13	0.73	1.36	1.00
<b>SD</b>	0.10	0.161	0.33	0.07	0.06	0.08
<b>COV</b>	0.116	0.138	0.15228	0.095	0.045	0.076
<b>CAGR (%)</b>	3.83	-4.445	-5.97	-5.23	-0.87	-1.47

Hero Motor reported the maximum mean value in terms of Asset Turnover followed by Maruti & Bajaj.

### Hypothesis:

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$  (Asset Turnover of Automobile Companies doesn't differ over years)

$H_1: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq \mu_6$  (Asset Turnover of Automobile Companies differ over years)

### Exhibit – 23: Asset Turnover: Anova

#### ANOVA: Single Factor

Groups	Count	Sum	Average	Variance
ASHOK LEYLAND	6	5.292844	0.882141	0.010514
BAJAJ	6	6.993916	1.165653	0.025946
HERO MOTOR	6	12.807765	2.134627	0.105671
MAHINDRA & MAHINDRA	6	4.387519	0.731253	0.004845
MARUTI	6	8.183496	1.363916	0.003764
TATA MOTORS	6	6.022860	1.003810	0.005798
ASHOK LEYLAND	6	5.292844	0.882141	0.010514

#### ANOVA: VARIATION

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	7.558326	5	1.51167	57.9411	1.65E-14	2.53355
Within Groups	0.782691	30	0.02609			
<b>Total</b>	<b>8.341018</b>	<b>35</b>				

Above analysis shows that the F value (57.9411) is more than the table value (2.53355) so, null hypothesis is rejected. Therefore it is concluded that Asset Turnover of Automobile Companies differs over the years

**F Score:** Joseph Piotroski devised a methodology based on 9 parameters to assess the overall financial strength of a Company. The points obtained from Profitability, Margin, Liquidity & Leverage are then added up to determine the best value stocks.

Parameters	Score
ROA>0	IF (ROA>0) then 1 else 0
CFO>0	IF (Cash flow from Operations>0) then 1 else 0
in ROA	IF (Current Year ROA/Total Asset - Previous Year ROA/Total Asset) > 0 then 1 else 0
in Accruals	IF(CFO- Income before Extraordinary Items)< 0 then 1 else 0
in Leverage	IF (Current Year Long Term Debt/Total Asset - Previous Year Long Term Debt/Total Asset) < 0 then 1 else 0
in Liquidity	IF (Current Year Current Ratio - Previous Year Current Ratio) > 0 then 1 else 0
in Equity	IF (Current Year Shares Outstanding - Previous Year Shares Outstanding) < 0 then 1 else 0
in Margin	IF (Current Year Gross Margin/Total Sales - Previous Year Gross Margin/Total Sales) > 0 then 1 else 0
in Asset T/O	IF (Current Year Total Sales/Total Asset - Previous Year Total Sales/Total Asset) > 0 then 1 else 0

**F Score = ROA+ CFO + ROA + ACCRUAL + LEVERAGE + LIQUIDITY + EQUITY + MARGIN + TURNOVER**

**Exhibit – 24: Piotroski Score: Ashok Leyland**

Year	2014		2015		2016		2017		2018		2019	
Net Income (ML)	1,18,592		1,57,082		2,17,279		2,32,654		3,00,533		3,36,207	
Total Assets (ML)	1,75,343		1,91,746		2,21,987		2,66,683		3,35,180		3,91,220	
PAT (ML)	-2,317		-2,140		7,122		16,329		18,138		21,946	
Return on Assets	<b>-1.3%</b>	<b>0</b>	<b>-1.1%</b>	<b>0</b>	<b>3.2%</b>	<b>1</b>	<b>6.1%</b>	<b>1</b>	<b>5.4%</b>	<b>1</b>	<b>5.6%</b>	<b>1</b>
				<b>1</b>		<b>1</b>		<b>1</b>		<b>0</b>		<b>1</b>
Operating Cash Flow (ML)	-1,040		951		-12,747		2,701		14,624		-37,455	
Operating CF/ Total Assets	<b>-0.59%</b>	<b>0</b>	<b>0.50%</b>	<b>1</b>	<b>-5.74%</b>	<b>0</b>	<b>1.01%</b>	<b>1</b>	<b>4.36%</b>	<b>1</b>	<b>-9.57%</b>	<b>0</b>
		<b>1</b>		<b>1</b>		<b>0</b>		<b>0</b>		<b>0</b>		<b>0</b>
Long-term Debt	86,363		92,500		114,733		134,517		163,450		198,859	
Long-term Debt/ TA	<b>49.25%</b>		<b>48.24%</b>	<b>1</b>	<b>51.68%</b>	<b>0</b>	<b>50.44%</b>	<b>1</b>	<b>48.76%</b>	<b>1</b>	<b>50.83%</b>	<b>0</b>
Current Ratio	0.77		0.8	<b>1</b>	0.92	<b>1</b>	0.99	<b>1</b>	0.86	<b>0</b>	0.9	<b>1</b>
Operating Margin %	8.73%		8.98%	<b>1</b>	12.23%	<b>1</b>	14.83%	<b>1</b>	14.77%	<b>0</b>	15.02%	<b>1</b>
Shares Outstanding (ML)	2,660.7		2,845.9	<b>0</b>	2,845.9	<b>1</b>	2,845.9	<b>1</b>	2,935.5	<b>0</b>	2,927.1	<b>1</b>
Asset Turnover	0.712		0.868	<b>1</b>	1.027	<b>1</b>	0.922	<b>0</b>	0.905	<b>0</b>	0.859	<b>0</b>
<b>Piotroski Score</b>	<b>1/3</b>		<b>7/9</b>		<b>6/9</b>		<b>7/9</b>		<b>3/9</b>		<b>5/9</b>	
<b>Piotroski Score (%)</b>	<b>33%</b>		<b>78%</b>		<b>67%</b>		<b>78%</b>		<b>33%</b>		<b>56%</b>	

Ashok Leyland's Piotroski Score have decreased from 7/9 to 6/9 in 2015-16 which have again fallen 7/9 to 3/9 in 2017-18. It again increased finally reached 5/9 in 2018-19.

**Exhibit – 25: Piotroski Score: Bajaj Auto**

Year	2014		2015		2016		2017		2018		2019	
Net Income (ML)	2,01,583		2,16,143		2,25,865		2,17,667		2,52,189		3,02,500	
Total Assets (ML)	1,53,078		1,65,146		1,72,404		2,16,376		2,51,410		2,88,344	
PAT (ML)	32,344		28,119		40,612		40,795		42,189		49,276	
Return on Assets	<b>21.1%</b>	<b>1</b>	<b>17.0%</b>	<b>1</b>	<b>23.6%</b>	<b>1</b>	<b>18.9%</b>	<b>1</b>	<b>16.8%</b>	<b>1</b>	<b>17.1%</b>	<b>1</b>
				<b>0</b>		<b>1</b>		<b>0</b>		<b>0</b>		<b>1</b>
Operating Cash Flow (ML)	35,017		21,138		36,899		32,674		43,278		24,869	
Operating CF/ Total Assets	<b>22.88%</b>	<b>1</b>	<b>12.80%</b>	<b>1</b>	<b>21.40%</b>	<b>1</b>	<b>15.10%</b>	<b>1</b>	<b>17.21%</b>	<b>1</b>	<b>8.62%</b>	<b>1</b>
		<b>1</b>		<b>0</b>		<b>0</b>		<b>0</b>		<b>1</b>		<b>0</b>
Long-term Debt	2,679		2,524		2,362		2,546		2,809		1,842	
Long-term Debt/ TA	<b>1.75%</b>		<b>1.53%</b>	<b>1</b>	<b>1.37%</b>	<b>1</b>	<b>1.18%</b>	<b>1</b>	<b>1.12%</b>	<b>1</b>	<b>0.64%</b>	<b>1</b>
Current Ratio	0.84		0.93	<b>1</b>	1.36	<b>1</b>	1.16	<b>0</b>	0.97	<b>0</b>	1.18	<b>1</b>
Operating Margin %	23.10%		18.92%	<b>0</b>	25.15%	<b>1</b>	25.68%	<b>1</b>	23.53%	<b>0</b>	23.01%	<b>0</b>
Shares Outstanding (ML)	289		289	<b>1</b>	289	<b>1</b>	289	<b>1</b>	289	<b>1</b>	289	<b>1</b>
Asset Turnover	1.317		1.309	<b>0</b>	1.310	<b>1</b>	1.006	<b>0</b>	1.003	<b>0</b>	1.049	<b>1</b>
<b>Piotroski Score</b>	<b>3/3</b>		<b>5/9</b>		<b>8/9</b>		<b>5/9</b>		<b>5/9</b>		<b>7/9</b>	
<b>Piotroski Score (%)</b>	<b>100%</b>		<b>56%</b>		<b>89%</b>		<b>56%</b>		<b>56%</b>		<b>78%</b>	

Bajaj Auto's Piotroski Score have decreased since FY 2016 & have remained constant 5/9 both in 2016-17 & 2017-18. During FY 2018-19 it have again increased and reached 7/9

**Exhibit – 26: Piotroski Score: Hero Motors**

Year	2014		2015		2016		2017		2018		2019	
Net Income (ML)	2,52,755		2,75,380		2,84,571		2,86,104		3,24,584		3,39,708	
Total Assets (ML)	1,01,216		1,08,683		1,28,958		1,53,120		1,73,967		1,85,044	
PAT (ML)	21,059		23,485		31,123		35,463		37,222		34,664	
Return on Assets	<b>20.8%</b>	<b>1</b>	<b>21.6%</b>	<b>1</b>	<b>24.1%</b>	<b>1</b>	<b>23.2%</b>	<b>1</b>	<b>21.4%</b>	<b>1</b>	<b>18.7%</b>	<b>1</b>
				<b>1</b>		<b>1</b>		<b>0</b>		<b>0</b>		<b>0</b>
Operating Cash Flow (ML)	29,630		21,855		37,224		40,072		40,172		10,323	
Operating CF/ Total Assets	<b>29.27%</b>	<b>1</b>	<b>20.11%</b>	<b>1</b>	<b>28.86%</b>	<b>1</b>	<b>26.17%</b>	<b>1</b>	<b>23.09%</b>	<b>1</b>	<b>5.58%</b>	<b>1</b>
		<b>1</b>		<b>0</b>		<b>1</b>		<b>1</b>		<b>1</b>		<b>0</b>
Long-term Debt	3,587		1,976		3,000		3,362		3,471		4,324	
Long-term Debt/ TA	<b>3.54%</b>		<b>1.82%</b>	<b>1</b>	<b>2.33%</b>	<b>0</b>	<b>2.20%</b>	<b>1</b>	<b>2.00%</b>	<b>1</b>	<b>2.34%</b>	<b>0</b>
Current Ratio	0.70		0.99	<b>1</b>	1.07	<b>1</b>	0.89	<b>0</b>	0.89	<b>0</b>	1.42	<b>1</b>
Operating Margin %	11.38%		12.52%	<b>1</b>	15.47%	<b>1</b>	17.17%	<b>1</b>	16.40%	<b>0</b>	15.13%	<b>0</b>
Shares Outstanding (ML)	199.7		199.7	<b>1</b>	199.7	<b>1</b>	199.7	<b>1</b>	199.7	<b>1</b>	199.7	<b>1</b>
Asset Turnover	2.50		2.53	<b>1</b>	2.21	<b>0</b>	1.87	<b>0</b>	1.87	<b>0</b>	1.84	<b>0</b>
<b>Piotroski Score</b>	<b>3/3</b>		<b>8/9</b>		<b>7/9</b>		<b>6/9</b>		<b>5/9</b>		<b>4/9</b>	
<b>Piotroski Score (%)</b>	<b>100%</b>		<b>89%</b>		<b>78%</b>		<b>67%</b>		<b>56%</b>		<b>44%</b>	

Hero Motor's Piotroski Score have decreased over the years since FY 2016 & have reached 4/9 during FY 2018-19.

**Exhibit – 27: Piotroski Score: Mahindra & Mahindra**

Year	2014		2015		2016		2017		2018		2019	
Net Income (ML)	7,40,009		7,14,480		7,58,414		8,37,731		9,20,940		10,47,207	
Total Assets (ML)	8,82,703		9,48,440		10,06,321		11,47,422		13,72,109		16,33,916	
PAT (ML)	43,234		25,927		35,545		40,505		79,578		60,169	
Return on Assets	<b>4.9%</b>	<b>1</b>	<b>2.7%</b>	<b>1</b>	<b>3.5%</b>	<b>1</b>	<b>3.5%</b>	<b>1</b>	<b>5.8%</b>	<b>1</b>	<b>3.7%</b>	<b>1</b>
				<b>0</b>		<b>1</b>		<b>0</b>		<b>1</b>		<b>0</b>
Operating Cash Flow (ML)	-2,437		10,549		23,848		1,831		6,819		-43,473	
Operating CF/ Total Assets	<b>-0.28%</b>	<b>0</b>	<b>1.11%</b>	<b>1</b>	<b>2.37%</b>	<b>1</b>	<b>0.16%</b>	<b>1</b>	<b>0.50%</b>	<b>1</b>	<b>-2.66%</b>	<b>0</b>
		<b>0</b>		<b>0</b>		<b>0</b>		<b>0</b>		<b>0</b>		<b>0</b>
Long-term Debt	2,54,918		2,23,270		2,35,988		3,01,245		3,38,092		4,35,262	
Long-term Debt/ TA	<b>28.88%</b>		<b>23.54%</b>	<b>1</b>	<b>23.45%</b>	<b>1</b>	<b>26.25%</b>	<b>0</b>	<b>24.64%</b>	<b>1</b>	<b>26.64%</b>	<b>0</b>
Current Ratio	3.09		3.18	<b>1</b>	3.28	<b>1</b>	3.26	<b>0</b>	3.17	<b>0</b>	2.95	<b>0</b>
Operating Margin %	11.86%		10.45%	<b>0</b>	13.18%	<b>1</b>	17.08%	<b>1</b>	15.54%	<b>0</b>	13.27%	<b>0</b>
Shares Outstanding (ML)	591.4		591.4	<b>1</b>	541.8	<b>1</b>	541.8	<b>1</b>	1,243.2	<b>0</b>	1,243.2	<b>1</b>
Asset Turnover	0.84		0.75	<b>0</b>	0.75	<b>1</b>	0.73	<b>0</b>	0.67	<b>0</b>	0.64	<b>0</b>
<b>Piotroski Score</b>	<b>1/3</b>		<b>5/9</b>		<b>8/9</b>		<b>4/9</b>		<b>4/9</b>		<b>2/9</b>	
<b>Piotroski Score (%)</b>	<b>33%</b>		<b>56%</b>		<b>89%</b>		<b>44%</b>		<b>44%</b>		<b>22%</b>	

Mahindra & Mahindra's Piotroski Score have decreased over the years since FY 2017 & have reached 2/9 during FY 2018-19.



**Exhibit – 28: Piotroski Score: Maruti Suzuki**

Year	2014		2015		2016		2017		2018		2019	
Net Income (ML)	4,43,963		5,08,014		5,75,890		6,80,850		7,98,094		8,60,685	
Total Assets (ML)	3,15,802		3,45,831		4,33,577		5,19,605		6,02,484		6,39,687	
PAT (ML)	28,316		37,906		54,972		75,110		78,807		76,506	
Return on Assets	<b>9.0%</b>	<b>1</b>	<b>11.0%</b>	<b>1</b>	<b>12.7%</b>	<b>1</b>	<b>14.5%</b>	<b>1</b>	<b>13.1%</b>	<b>1</b>	<b>12.0%</b>	<b>1</b>
				<b>1</b>		<b>1</b>		<b>1</b>		<b>0</b>		<b>0</b>
Operating Cash Flow (ML)	49,946		65,391		84,825		102,820		117,879		66,009	
Operating CF/ Total Assets	<b>15.82%</b>	<b>1</b>	<b>18.91%</b>	<b>1</b>	<b>19.56%</b>	<b>1</b>	<b>19.79%</b>	<b>1</b>	<b>19.57%</b>	<b>1</b>	<b>10.32%</b>	<b>1</b>
		<b>1</b>		<b>1</b>		<b>1</b>		<b>1</b>		<b>1</b>		<b>0</b>
Long-term Debt	24,524		10,679		10,532		16,110		17,332		22,362	
Long-term Debt/ TA	<b>7.77%</b>		<b>3.09%</b>	<b>1</b>	<b>2.43%</b>	<b>1</b>	<b>3.10%</b>	<b>0</b>	<b>2.88%</b>	<b>1</b>	<b>3.50%</b>	<b>0</b>
Current Ratio	0.97		0.75	<b>0</b>	0.78	<b>1</b>	0.64	<b>0</b>	0.55	<b>0</b>	0.65	<b>1</b>
Operating Margin %	8.41%		9.80%	<b>1</b>	13.17%	<b>1</b>	14.87%	<b>1</b>	13.99%	<b>0</b>	12.34%	<b>0</b>
Shares Outstanding (ML)	302.1		302.1	<b>1</b>	302.1	<b>1</b>	302.1	<b>1</b>	302.1	<b>1</b>	302.1	<b>1</b>
Asset Turnover	1.41		1.47	<b>1</b>	1.33	<b>0</b>	1.31	<b>0</b>	1.32	<b>1</b>	1.35	<b>1</b>
<b>Piotroski Score</b>	<b>3/3</b>		<b>8/9</b>		<b>8/9</b>		<b>6/9</b>		<b>6/9</b>		<b>5/9</b>	
<b>Piotroski Score (%)</b>	<b>100%</b>		<b>89%</b>		<b>89%</b>		<b>67%</b>		<b>67%</b>		<b>56%</b>	

Maruti Suzuki Piotroski Score have decreased since FY 2017 & have remained constant in both 2017 & 2017 and finally decreased and reached 5/9 during FY 2018-19

**Exhibit – 29: Piotroski Score: Tata Motors**

Year	2014		2015		2016		2017		2018		2019	
Net Income (ML)	23,28,337		26,31,590		27,30,456		26,96,925		29,15,505		30,19,384	
Total Assets (ML)	21,99,983		23,86,580		26,92,976		27,37,544		33,13,505		30,71,945	
PAT (ML)	1,41,042		1,40,597		1,11,007		60,636		68,131		-2,89,337	
Return on Assets	<b>6.4%</b>	<b>1</b>	<b>5.9%</b>	<b>1</b>	<b>4.1%</b>	<b>1</b>	<b>2.2%</b>	<b>1</b>	<b>2.1%</b>	<b>1</b>	<b>-9.4%</b>	<b>0</b>
				<b>0</b>		<b>0</b>		<b>0</b>		<b>0</b>		<b>0</b>
Operating Cash Flow (ML)	3,61,512		3,55,313		3,78,995		3,01,993		2,38,574		1,88,908	
Operating CF/ TA	<b>16.43%</b>	<b>1</b>	<b>14.89%</b>	<b>1</b>	<b>14.07%</b>	<b>1</b>	<b>11.03%</b>	<b>1</b>	<b>7.20%</b>	<b>1</b>	<b>6.15%</b>	<b>1</b>
		<b>1</b>		<b>1</b>		<b>1</b>		<b>1</b>		<b>1</b>		<b>1</b>
Long-term Debt	7,58,501		9,83,199		9,55,141		11,68,638		11,43,283		13,52,682	
Long-term Debt/ TA	<b>34.48%</b>		<b>41.20%</b>	<b>0</b>	<b>35.47%</b>	<b>1</b>	<b>42.69%</b>	<b>0</b>	<b>34.50%</b>	<b>1</b>	<b>44.03%</b>	<b>0</b>
Current Ratio	1.36		1.23	<b>0</b>	1.15	<b>0</b>	1.20	<b>1</b>	1.23	<b>1</b>	1.33	<b>1</b>
Operating Margin %	10.14%		10.09%	<b>0</b>	6.96%	<b>0</b>	5.03%	<b>0</b>	5.43%	<b>1</b>	-8.48%	<b>0</b>
Shares Outstanding (ML)	3,219.4		3,219.4	<b>1</b>	2,887.3	<b>1</b>	2,887.3	<b>1</b>	2,887.3	<b>1</b>	2,887.3	<b>1</b>
Asset Turnover	1.06		1.10	<b>1</b>	1.01	<b>0</b>	0.99	<b>0</b>	0.88	<b>0</b>	0.98	<b>1</b>
<b>Piotroski Score</b>	<b>3/3</b>		<b>5/9</b>		<b>5/9</b>		<b>5/9</b>		<b>7/9</b>		<b>5/9</b>	
<b>Piotroski Score (%)</b>	<b>100%</b>		<b>56%</b>		<b>56%</b>		<b>56%</b>		<b>78%</b>		<b>56%</b>	

Tata Motor's Piotroski Score have remained constant over the years (5/9) except during 2017-18 where it increased to 7/9 & again dropped to 5/9 during 2018-19.

**Exhibit – 30: Piotroski Score: Automobile Companies**

Year	Ashok Leyland	Bajaj	Hero Motor	Mahindra & Mahindra	Maruti	Tata Motors
2014	0.33	1	1	0.33	1	1
2015	0.78	0.56	0.89	0.56	0.89	0.56
2016	0.67	0.89	0.78	0.89	0.89	0.56
2017	0.78	0.56	0.67	0.44	0.67	0.56
2018	0.33	0.56	0.56	0.44	0.67	0.78
2019	0.56	0.78	0.44	0.22	0.56	0.56
<b>Mean</b>	0.57	0.72	0.72	0.48	0.78	0.67
<b>SD</b>	0.20	0.196	0.21	0.23	0.17	0.19
<b>COV</b>	0.355	0.271	0.28782	0.477	0.221	0.279
<b>CAGR (%)</b>	10.76	-4.902	-14.97	-7.79	-11.09	-11.09

Maruti reported the highest mean in terms of Piotroski Score followed by Bajaj Auto & Hero Motor. CAGR of all Automobile Companies have been Negative except Ashok Leyland.

**Hypothesis:**

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$  (Piotroski Score of Automobile Companies doesn't differ over years)

$H_1: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq \mu_6$  (Piotroski Score of Automobile Companies differ over years)

**Exhibit – 31: Piotroski Score: Anova**

**ANOVA: Single Factor**

Groups	Count	Sum	Average	Variance
ASHOK LEYLAND	6	3.444444	0.574074	0.041564
BAJAJ	6	4.333333	0.722222	0.038272
HERO MOTOR	6	4.333333	0.722222	0.043210
MAHINDRA & MAHINDRA	6	2.888889	0.481481	0.052675
MARUTI	6	4.666667	0.777778	0.029630
TATA MOTORS	6	4	0.666667	0.034568
ASHOK LEYLAND	6	3.444444	0.574074	0.041564

**ANOVA: VARIATION**

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.365226	5	0.073045	1.82676	0.137669	2.53355
Within Groups	1.199588	30	0.039986			
<b>Total</b>	1.564815	35				

Above analysis shows that the F value (1.82676) is less than the table value (2.53355) so, null hypothesis is rejected. Therefore it is concluded that Piotroski Score of Automobile Companies does not differ significantly over the years.

**T-Test:** It is used to determine the difference between two sample means from two normally distributed populations with unknown variances. It uses small sample size in order to test the difference between the samples when two normal distributions are unknown. If t Stat value lies between - t Critical two tail and + t Critical two test we don't reject Null Hypothesis.

**Piotroski Score** is used to assess financial strength of a company. This Score helps to determine is used the value stocks. An analyze have been done by conducting T Test to show the effect of Operating Cash Flows/Total Assets, Long Term Debt/Total Asset,  $MV_E/BV_E$ , ROE & F Score on P/E ratio.

**Exhibit – 32: T-Test: Two-Sample Assuming Unequal Variances: Ashok Leyland**

	Operating CF/TA	LTD/TA	MV <sub>E</sub> / BV <sub>E</sub>	ROE	F SCORE	P/E
Mean	-1.6729	0.4987	3.9203	0.1301	0.5741	-4.8303
Variance	25.6999	0.0002	0.6229	0.0221	0.0416	1766.8243
Observations	6	6	6	6	6	6
Hypothesized Mean Difference	0	0	0	0	0	
df	5	5	5	5	5	
<b>t Stat</b>	<b>0.1827</b>	<b>0.3105</b>	<b>0.5098</b>	<b>0.2891</b>	<b>0.3149</b>	
P(T<=t) one-tail	0.43112	0.38434	0.31593	0.39207	0.38277	
t Critical one-tail	2.01505	2.01505	2.01505	2.01505	2.01505	
P(T<=t) two-tail	0.86223	0.76867	0.63186	0.78413	0.76553	
<b>t Critical two-tail</b>	<b>2.570582</b>	<b>2.570582</b>	<b>2.570582</b>	<b>2.570582</b>	<b>2.570582</b>	

**Operating Cash Flow/Total Assets & Price-Earnings (P/E) Ratio**

H<sub>0</sub>:  $\mu_1^2 = \mu_2^2$  (There is significant relationship between Operating Cash Flow/TA & P/E, Variance is not Equal)

H<sub>1</sub>:  $\mu_1^2 \neq \mu_2^2$  (There is significant no relationship between Operating Cash Flow/TA & P/E, Variance is Equal)

Here, t Stat value lies between - 2.570582 & + 2.570582. Therefore, we reject Null Hypothesis stating that variances are equal.

**Long Term Debt/ Total Assets & Price-Earnings (P/E) Ratio**

H<sub>0</sub>:  $\mu_1^2 = \mu_2^2$  (There is significant relationship between Long Term Debt/TA & P/E, Variance is not Equal)

H<sub>1</sub>:  $\mu_1^2 \neq \mu_2^2$  (There is significant no relationship between Long Term Debt/TA & P/E, Variance is Equal)

Here, t Stat value lies between - 2.570582 & + 2.570582. Therefore, we reject Null Hypothesis stating that variances are equal.

**Mv<sub>e</sub> / Bv<sub>e</sub> & Price-Earnings (P/E) Ratio**

H<sub>0</sub>:  $\mu_1^2 = \mu_2^2$  (There is significant relationship between MV<sub>E</sub> / BV<sub>E</sub> & P/E, Variance is not Equal)

H<sub>1</sub>:  $\mu_1^2 \neq \mu_2^2$  (There is significant no relationship between MV<sub>E</sub> / BV<sub>E</sub> & P/E, Variance is Equal)

Here, t Stat value lies between - 2.570582 & + 2.570582. Therefore, we reject Null Hypothesis stating that variances are equal.

**Roe & Price-Earnings (P/E) Ratio**

H<sub>0</sub>:  $\mu_1^2 = \mu_2^2$  (There is significant relationship between ROE & P/E, Variance is not Equal)

H<sub>1</sub>:  $\mu_1^2 \neq \mu_2^2$  (There is significant no relationship between ROE & P/E, Variance is Equal)

Here, t Stat value lies between - 2.570582 & + 2.570582. Therefore, we reject Null Hypothesis stating that variances are equal.

**F Score & Price-Earnings (P/E) Ratio**

H<sub>0</sub>:  $\mu_1^2 = \mu_2^2$  (There is significant relationship between F Score & P/E, Variance is not Equal)

H<sub>1</sub>:  $\mu_1^2 \neq \mu_2^2$  (There is significant no relationship between F Score & P/E, Variance is Equal)

Here, t Stat value lies between - 2.570582 & + 2.570582. Therefore, we reject Null Hypothesis stating that variances are equal.

**Exhibit – 33: T-TEST: Two-Sample Assuming Unequal Variances: Bajaj Auto**

	Operating CF/TA	LTD/TA	MV <sub>E</sub> / BV <sub>E</sub>	ROE	F SCORE	P/E
Mean	16.3361	0.0126	4.5776	0.2514	0.7222	18.3864
Variance	28.5403	0.0000	0.6807	0.0020	0.0383	7.8709
Observations	6	6	6	6	6	6

Hypothesized Mean Difference	0	0	0	0	0	
df	8	5	6	5	5	
<b>t Stat</b>	<b>-0.8323</b>	<b>-16.0421</b>	<b>-11.5667</b>	<b>-15.8316</b>	<b>-15.3852</b>	
P(T<=t) one-tail	0.2147	0.0000	0.0000	0.0000	0.0000	
t Critical one-tail	1.8595	2.0150	1.9432	2.0150	2.0150	
P(T<=t) two-tail	0.4294	0.0000	0.0000	0.0000	0.0000	
<b>t Critical two-tail</b>	<b>2.306004</b>	<b>2.570582</b>	<b>2.446912</b>	<b>2.570582</b>	<b>2.570582</b>	

#### Operating Cash Flow/Total Assets & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between Operating Cash Flow/ TA & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between Operating Cash Flow/ TA & P/E, Variance is Equal)

Here, t Stat value lies between -2.306004 & +2.306004. Therefore, we reject Null Hypothesis stating that variances are equal.

#### Long Term Debt/ Total Assets & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between Long Term Debt/TA & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between Long Term Debt/TA & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.

#### MV<sub>E</sub> / BV<sub>E</sub> & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between MV<sub>E</sub> / BV<sub>E</sub> & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between MV<sub>E</sub> / BV<sub>E</sub> & P/E, Variance is Equal)

Here, t Stat value does not lie -2.446912 & +2.446912. Therefore, we accept Null Hypothesis stating that variances are not equal.

#### Roe & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between ROE & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between ROE & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.

#### F Score & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between F Score & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between F Score & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.

#### Exhibit – 34: T-TEST: Two-Sample Assuming Unequal Variances: Hero Motor

	Operating CF/TA	LTD/ TA	MV <sub>E</sub> / BV <sub>E</sub>	ROE	F SCORE	P/E
Mean	22.181	0.024	6.530	0.334	0.722	19.437
Variance	78.334	0.000	1.764	0.002	0.043	5.502
Observations	6	6	6	6	6	6
Hypothesized Mean Difference	0	0	0	0	0	
df	6	5	8	5	5	
<b>t Stat</b>	<b>0.734</b>	<b>-20.272</b>	<b>-11.729</b>	<b>-19.945</b>	<b>-19.467</b>	
P(T<=t) one-tail	0.2452	0.0000	0.0000	0.0000	0.0000	
t Critical one-tail	1.9432	2.0150	1.8595	2.0150	2.0150	
P(T<=t) two-tail	0.490479	5.4E-06	2.55E-06	5.85E-06	6.6E-06	
<b>t Critical two-tail</b>	<b>2.4469</b>	<b>2.570582</b>	<b>2.306004</b>	<b>2.570582</b>	<b>2.570582</b>	

### Operating Cash Flow/Total Assets & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between Operating Cash Flow/TA & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between Operating Cash Flow/TA & P/E, Variance is Equal)

Here, t Stat value lies between -2.4469 & +2.4469. Therefore, we reject Null Hypothesis stating that variances are equal.

### Long Term Debt/ Total Assets & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between Long Term Debt/TA & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between Long Term Debt/TA & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.

### MV<sub>E</sub> / BV<sub>E</sub> & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between MV<sub>E</sub> / BV<sub>E</sub> & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between MV<sub>E</sub> / BV<sub>E</sub> & P/E, Variance is Equal)

Here, t Stat value does not lie -2.30604 & +2.30604. Therefore, we accept Null Hypothesis stating that variances are not equal.

### Roe & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between ROE & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between ROE & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.

### F Score & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between F Score & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between F Score & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.

**Exhibit – 35: T-TEST: Two-Sample Assuming Unequal Variances: MAHINDRA & MAHINDRA**

	Operating CF/TA	LTD/TA	MV <sub>E</sub> /BV <sub>E</sub>	ROE	F SCORE	P/E
Mean	0.2003	0.2557	1.9881	0.1510	0.4815	24.4521
Variance	2.8080	0.0004	0.0324	0.0019	0.0527	15.3673
Observations	6	6	6	6	6	6
Hypothesized Mean Difference	0	0	0	0	0	
df	7	5	5	5	5	
<b>t Stat</b>	<b>-13.934</b>	<b>-15.119</b>	<b>-14.022</b>	<b>-15.184</b>	<b>-14.952</b>	
P(T<=t) one-tail	1.16E-06	1.15E-05	1.66E-05	1.12E-05	1.21E-05	
t Critical one-tail	1.894579	2.015048	2.015048	2.015048	2.015048	
P(T<=t) two-tail	2.32E-06	2.29E-05	3.32E-05	2.25E-05	2.42E-05	
<b>t Critical two-tail</b>	<b>2.36462</b>	<b>2.570582</b>	<b>2.570582</b>	<b>2.570582</b>	<b>2.570582</b>	

### Operating Cash Flow/Total Assets & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between Operating Cash Flow/TA & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between Operating Cash Flow/TA & P/E, Variance is Equal)

Here, t Stat value does not lie -2.3462 & +2.3462. Therefore, we accept Null Hypothesis stating that variances are not equal.

### Long Term Debt/ Total Assets & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between Long Term Debt/TA & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between Long Term Debt/TA & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.

### MV<sub>E</sub> / BV<sub>E</sub> & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between MV<sub>E</sub> / BV<sub>E</sub> & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between MV<sub>E</sub> / BV<sub>E</sub> & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.

### Roe & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between ROE & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between ROE & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.

### F Score & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between F Score & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between F Score & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.

**Exhibit – 36: T-TEST: Two-Sample Assuming Unequal Variances: MARUTI SUZUKI**

	Operating CF/TA	LTD/TA	MV <sub>E</sub> /BV <sub>E</sub>	ROE	F SCORE	P/E
Mean	17.2834	0.0383	4.2461	0.1696	0.7778	24.9603
Variance	13.8408	0.0004	1.7057	0.0006	0.0296	39.3072
Observations	6	6	6	6	6	6
Hypothesized Mean Difference	0	0	0	0	0	
df	8	5	5	5	5	
<b>t Stat</b>	<b>-2.5794</b>	<b>-9.7369</b>	<b>-7.9229</b>	<b>-9.6856</b>	<b>-9.4445</b>	
P(T<=t) one-tail	0.016324	9.71E-05	0.000258	9.96E-05	0.000112	
t Critical one-tail	1.859548	2.015048	2.015048	2.015048	2.015048	
P(T<=t) two-tail	0.032647	0.000194	0.000516	0.000199	0.000225	
<b>t Critical two-tail</b>	<b>2.306004</b>	<b>2.570582</b>	<b>2.570582</b>	<b>2.570582</b>	<b>2.570582</b>	

### Operating Cash Flow/Total Assets & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between Operating Cash Flow/TA & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between Operating Cash Flow/TA & P/E, Variance is Equal)

Here, t Stat value does not lie -2.306004 & +2.306004. Therefore, we accept Null Hypothesis stating that variances are not equal.

### Long Term Debt/ Total Assets & Price-Earnings (P/E) Ratio

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between Long Term Debt/TA & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between Long Term Debt/TA & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.



**MV<sub>E</sub> / BV<sub>E</sub> & Price-Earnings (P/E) Ratio**

H<sub>0</sub>:  $\mu_1^2 = \mu_2^2$  (There is significant relationship between MV<sub>E</sub> / BV<sub>E</sub> & P/E, Variance is not Equal)

H<sub>1</sub>:  $\mu_1^2 \neq \mu_2^2$  (There is significant no relationship between MV<sub>E</sub> / BV<sub>E</sub> & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.

**Roe & Price-Earnings (P/E) Ratio**

H<sub>0</sub>:  $\mu_1^2 = \mu_2^2$  (There is significant relationship between ROE & P/E, Variance is not Equal)

H<sub>1</sub>:  $\mu_1^2 \neq \mu_2^2$  (There is significant no relationship between ROE & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.

**F Score & Price-Earnings (P/E) Ratio**

H<sub>0</sub>:  $\mu_1^2 = \mu_2^2$  (There is significant relationship between F Score & P/E, Variance is not Equal)

H<sub>1</sub>:  $\mu_1^2 \neq \mu_2^2$  (There is significant no relationship between F Score & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.

**Exhibit – 37: T-TEST: Two-Sample Assuming Unequal Variances: TATA MOTORS**

	Operating CF/TA	LTD/TA	MV <sub>E</sub> / BV <sub>E</sub>	ROE	F SCORE	P/E
Mean	11.6292	0.3873	1.8331	0.0501	0.6667	25.1047
Variance	17.9335	0.0019	0.4511	0.0721	0.0346	223.4522
Observations	6	6	6	6	6	6
Hypothesized Mean Difference	0	0	0	0	0	
df	6	5	5	5	5	
<b>t Stat</b>	<b>-2.1245</b>	<b>-4.0503</b>	<b>-3.8095</b>	<b>-4.1049</b>	<b>-4.0042</b>	
P(T<=t) one-tail	0.038897	0.004911	0.006253	0.004655	0.00514	
t Critical one-tail	1.94318	2.015048	2.015048	2.015048	2.015048	
P(T<=t) two-tail	0.077794	0.009823	0.012506	0.00931	0.010281	
<b>t Critical two-tail</b>	<b>2.4469</b>	<b>2.570582</b>	<b>2.570582</b>	<b>2.570582</b>	<b>2.570582</b>	

**Operating Cash Flow/Total Assets & Price-Earnings (P/E) Ratio**

H<sub>0</sub>:  $\mu_1^2 = \mu_2^2$  (There is significant relationship between Operating Cash Flow/TA & P/E, Variance is not Equal)

H<sub>1</sub>:  $\mu_1^2 \neq \mu_2^2$  (There is significant no relationship between Operating Cash Flow/TA & P/E, Variance is Equal)

Here, t Stat value lies -2.4469 & +2.4469. Therefore, we reject Null Hypothesis stating that variances are equal.

**Long Term Debt/ Total Assets & Price-Earnings (P/E) Ratio**

H<sub>0</sub>:  $\mu_1^2 = \mu_2^2$  (There is significant relationship between Long Term Debt/TA & P/E, Variance is not Equal)

H<sub>1</sub>:  $\mu_1^2 \neq \mu_2^2$  (There is significant no relationship between Long Term Debt/TA & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.

**MV<sub>E</sub> / BV<sub>E</sub> & Price-Earnings (P/E) Ratio**

H<sub>0</sub>:  $\mu_1^2 = \mu_2^2$  (There is significant relationship between MV<sub>E</sub> / BV<sub>E</sub> & P/E, Variance is not Equal)

H<sub>1</sub>:  $\mu_1^2 \neq \mu_2^2$  (There is significant no relationship between MV<sub>E</sub> / BV<sub>E</sub> & P/E, Variance is Equal)

Here, t Stat value does not lie -2.570582 & +2.570582. Therefore, we accept Null Hypothesis stating that variances are not equal.

**Roe & Price-Earnings (P/E) Ratio**

H<sub>0</sub>:  $\mu_1^2 = \mu_2^2$  (There is significant relationship between ROE & P/E, Variance is not Equal)

H<sub>1</sub>:  $\mu_1^2 \neq \mu_2^2$  (There is significant no relationship between ROE & P/E, Variance is Equal)



Here, t Stat value does not lie  $-2.570582$  &  $+2.570582$ . Therefore, we accept Null Hypothesis stating that variances are not equal.

### **F Score & Price-Earnings (P/E) Ratio**

$H_0: \mu_1^2 = \mu_2^2$  (There is significant relationship between F Score & P/E, Variance is not Equal)

$H_1: \mu_1^2 \neq \mu_2^2$  (There is significant no relationship between F Score & P/E, Variance is Equal)

Here, t Stat value does not lie  $-2.570582$  &  $+2.570582$ . Therefore, we accept Null Hypothesis stating that variances are not equal.

### **Conclusion**

F-score is a binary scoring system with 9 variables focusing on profitability, leverage, liquidity & operating efficiency. The aim of F-score is to identify financially strong firms on the basis of F-score. A firm with high F-score is expected to have strong financial performance in terms of Profitability & Liquidity which in turn will have an impact on its P/E.

**F-Score does not anchor to specific values in the companies' fundamentals. Instead, F-Score focuses on:**

- a) Direction in which the fundamentals of a company are trending &
- b) Whether general financial health conditions are met

### **Anova Findings**

1. The study reveals that:
2. Ashok Leyland reported maximum CAGR of 23.2% followed by Maruti, indicating the maximum growth in Revenue. F value (300.3469) is more than the table value (2.53355) so; null hypothesis is rejected indicating Revenue differs over the years.
3. Hero Motor reported the highest mean value in terms of Return on Assets followed by Bajaj Auto & Maruti. F value (43.6328) is more than the table value (2.53355) so; null hypothesis is rejected indicating ROTA differs over the years.
4. Mahindra & Mahindra reported the maximum CAGR of 57.32% in terms of Operating Cash Flows/TA. F value (20.27089) is more than the table value (2.53355) so; null hypothesis is rejected indicating OP CF/TA differs over the years.
5. Bajaj, Hero Motor, Mahindra & Mahindra & Maruti all reported a Negative CAGR depicting the fall in Debt/Asset ratio over the years. F value (529.0368) is more than the table value (2.53355) so, null hypothesis is rejected indicating Operating Long-Term Debt / Total Assets of Automobile Companies differs over the years
6. Hero Motor reported the maximum CAGR of 14.98% indicating the maximum growth in Current Ratio over the period
7. Bajaj reported the maximum mean value in terms of Operating Margin followed by Hero Motor, Mahindra & Mahindra & Ashok Leyland.
8. Maruti reported the highest mean in terms of Piotroski Score followed by Bajaj Auto & Hero Motor.

### **T-Test Conducted with selected Cement Firms revealed that**

1. There is significant relationship between Operating Cash Flow/Total Assets & P/E Ratio
2. There is significant relationship between Long Term Debt/ Total Assets & P/E Ratio
3. There is significant relationship between  $MV_E / BV_E$  & P/E Ratio
4. There is significant relationship between ROE & P/E Ratio
5. There is significant relationship between F Score & P/E Ratio





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