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# Optimizing Fund Performance: A Communication Systems Approach to Data Mining in Large- Cap Equity Mutual Funds



**Abstract:** - Mutual funds represent a secure and technologically driven conduit for Indian investors to engage with the dynamic Indian financial markets. These professionally managed funds strategically allocate investments across a spectrum of securities, including equities, bonds, government securities, and gold, leveraging cutting-edge information technology infrastructure for seamless operation and optimization. Within this landscape, performance emerges as a pivotal metric, driving the flow of savings into these digitally enabled funds, indicative of investors' confidence and expectations in the realm of data-driven decision-making. The core objective of this paper is to construct a robust mutual fund performance evaluation model utilizing the Statistical Package for the Social Sciences (SPSS), a sophisticated software platform renowned for its advanced analytics and predictive modeling capabilities in the information technology domain. The work focused specifically on equity mutual funds, this study meticulously examines top-rated funds within the large-cap category, drawing insights from a comprehensive validation period spanning the last fifteen years from April 2007 to March 2021. Through the systematic evaluation of various performance metrics within the context of information technology-driven analysis, this model aims to deliver actionable insights and strategic foresight, benefiting researchers, society, and financial analysts alike, while catalyzing innovation and driving positive impacts in the intersection of technology and finance.

**Keywords:** Mutual fund, SPSS, performance evaluation, Net Asset Value (NAV), Expense Ratio

## 1. INTRODUCTION

In the ever-evolving landscape of information technology, Equity Mutual funds serve as pivotal conduits, leveraging cutting-edge digital platforms to empower Indian investors in navigating the intricacies of equity markets and realizing outsize returns compared to conventional savings avenues. While historical performance metrics undeniably serve as cornerstones for evaluation, a nuanced approach necessitates a deeper dive into multifaceted indicators such as risk, volatility, and resilience (Brindha et al., 2007). In an era brimming with investment possibilities, investors rely on performance evaluation metrics as guiding beacons, steering their financial decisions in alignment with their objectives and risk appetites (Alsakran et al., 2009). Simultaneously, fund managers harness these metrics as compasses, charting the trajectory of fund performance across temporal horizons and juxtaposing against industry benchmarks to unearth opportunities for optimization and growth (Alsakran et al., 2009). However, beneath the surface of performance metrics lies a labyrinth of factors shaping mutual fund efficacy. Market risk, fund correlation dynamics, and tax implications intricately weave webs of influence, significantly impacting investment outcomes (Sagar et al., 2018). Yet, amidst the cacophony of variables, critical nuances such as fund origin, investment risk profiles, and temporal considerations often remain overlooked, potentially obscuring holistic evaluations. Thus, this paper embarks on a transformative journey to illuminate these underappreciated facets, wielding the formidable analytical prowess of SPSS statistical software by IBM (Ma et al., 2018). Renowned for its robust data analytics and predictive modeling capabilities, SPSS emerges as an indispensable tool, empowering researchers to unearth insights and unlock the latent potential of vast data reservoirs (Ma et al., 2018). Structured as a tapestry interwoven with interdisciplinary threads, this article marries insights from finance, information technology, and data science, painting a holistic portrait of mutual fund performance evaluation in the digital age. Through a meticulous

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review of scholarly literature and an exhaustive exploration of performance metrics, it lays the groundwork for a methodical analysis employing SPSS. By elucidating the methodology and presenting empirical findings, it not only illuminates the current landscape of mutual fund performance but also charts a course for future research endeavors. In summation, this article underscores the symbiotic relationship between technology and finance, wherein innovative tools like SPSS serve as catalysts, propelling informed decision-making and reshaping the contours of investment management in an increasingly digitized world.

## 2. LITERATURE SURVEY

The measurement of the performance of the mutual funds is very important these days for both investors as well as portfolio managers. Every researcher uses different metrics to measure the performance of mutual funds. Some main metrics to check the performance of mutual funds are Treynor ratio (1965), Sharpe ratio (1966), Jensen ratio (1969). Talluru (1997) verify that the choice of the performance measure is important for mutual fund ranking and selection (Bogle et al. 1992). Authors cuiyi (2016) builds evaluation index sets including fund companies, fund managers, risk levels and the level of risk-adjusted earnings to measure the performance and classify the mutual funds based upon their performance. To make the evaluation index sets, Support Vector Machine (SVM) model is used in this paper. Wang Kehluh et al. (2008) purposed a performance evaluation model by using the Fast Adaptive Neural Network Classifier (FANNC). Singla et al. (2021) discusses about some of the best NAV prediction models which are used to predict the future trend of any mutual fund. This paper also compared its results with previous purposed model utilizing Back-Propagation Neural Network (BPN). Lu Ruei-Shan et al. (2008) studies the performance of the mutual funds by using Smooth Support Vector Regression model and Back Propagation network. Singla et al. (2022) discusses about the pre-processing techniques which are used to pre-process any raw data to the structured and understandable format. This paper used return on market and return on performance as the output variable to get the top performed mutual funds. Hassan Qamar et al. (2016) used non-parametric frontier method such as Data Envelopment Analysis method to analyse the efficiency and performance of mutual funds. This method used factors such as returns of the fund, turnover rate, volatility, expense ratio as the input and gets the number of funds with good return and stability in nature as a result to the input. Pendaraki et al. 2002 tells about the research analysis on mutual funds. This area is very extensive and controversial, so researcher discusses about all the factors and risk involved during analysis. Singla et al. (2020) discusses about the performance evaluation of mutual funds with the help of different models and analyze their results. Latha et al. (2016) explore different cases studies related to evaluation of performance of mutual funds. These studies discusses about all the risks and returns related to performance of mutual funds. Tripathy et al. (2020) discusses about the different types of mutual funds and tells about the security fund return in respect to fund return. Aruna et al. (2020) discusses about all the pre-processing techniques which can be applied upon raw data to convert the data into structured data. These techniques can apply to imbalanced emails classification system. Aljuaid et al. (2016) analyze all the different techniques used to handle missing values in bulk of data. All the methods to handle missing values are discussed thoroughly.

Many studies on Greek mutual funds' performance evaluation based on traditional fund performance measures have been undertaken. These are some researchers who used these measures through multi-criteria analysis to check the performance of Greek mutual funds Handjinicolaou(1980), Milonas (1999), Philippas (1999), Sorros (2003), Artikis (2004),Pendaraki et al. (2003, 2005). These measures are also used through argumentation-based decision-making theory to check the performance of mutual funds by Pendaraki and Spanoudakis(2012).

## 3. MUTUAL FUND'S PERFORMANCE METRICS

Mutual funds' performance is vital indicator to keep in check for every investor & fund manager. Equity Mutual funds' performance is directly linked to performance of capital markets. So, Returns in Mutual funds are not in linear fashion as the case in conventional saving instruments like FD, Government bonds etc. Returns in Mutual funds are in nonlinear fashion and can face extreme up and down as per the market conditions. Bull Markets as we say are phases of extreme optimism where returns are extraordinary high and Bear Markets are phases of extreme pessimism and returns are extremely negative. Markets can remain irrational for longer time. So, Performance evaluation has to be done over a longer period of time where we can evaluate performance against couple of complete bull and bear cycles (Afroz 2017). In this paper, we have considered data for a period of 15

years from 2007 to 2021 which include two major bear cycles of Subprime crisis 2007 and Covid crisis in 2020 (Abdulla et al. 2021). Investors select the funds depending upon the risk appetite to generate some extra returns with respect to traditional saving instruments and also other mutual funds in same category. Performance of funds in same category varies widely and is dependent on many factors like fund manager expertise, churn ratio, diversification, expense ratio etc. The baseline for fund manager is to beat the Index returns and create additional returns for the investors (Ashraf et al. 2014). Some key metrics like risk, volatility, resilience, alpha etc need to be studied in tandem with returns so that a comprehensive performance can be evaluated for a particular fund which can be compared with similar funds in same or different category ( Muruthy et al. 2022). A number of researches are done to check the performance of mutual fund. There are a lot of metrics which have been used by number of researchers to measure the performance of mutual fund like compound return over different years, Treynor’s ratio, Sharpe ratio, Jensen ratio etc (Iemeshko et al. 2015). In this research work, we have considered Compounded Annual Growth rate over different time periods & internal rate of return as core parameters of return parameter. Excessive returns against benchmark index and volatility are measured by Alpha and Beta. Risk adjusted returns are evaluated by Treynor’s ratio, Sharpe ratio, Jensen ratio etc. Resilience and Sturdiness is measured by evaluating Maximum Drawdown and Maximum Recoup Time to regain the Drawdown (Raju et al. 2018). Detailed Evaluation of these metrics is as following[39][40].

- 3.1 Compound Annual Growth Rate (CAGR) of 15,10,5 and 3 years:** The Compound Annual Growth Rate (CAGR) is the annualized average rate of return on the investment between two given years. Higher the value of CAGR, better is the performance. It is an easy way to check the overall performance of any fund over specific period of time longer than one year. However, CAGR value ignores the volatility within specified time period. In this research paper, CAGR returns of fund were checked against benchmark NIFTY at interval of 15-year, 10-year, 5-year and 3-years (Ritesh 2016). Higher CAGR value over a longer period indicates greater stability of returns [41][42].
- 3.2 Extended Rate of return (XIRR):** Investors generally invest in Mutual funds by SIP or multiple lump sum investments. XIRR calculates the rate of return generated by investor on multiple cash inflows and outflows at different intervals of time. For purpose of our study, we have evaluated XIRR of each fund assuming investor has deposited same amount of money each time the NAV of Mutual fund has fallen by 1% or more in a day. XIRR give more comprehensive view on actual returns generated by investor
- 3.3 Alpha:** Alpha calculates the excess or deficit return of a fund relative to the benchmark index. This value is simply calculated by subtracting the fund returns and benchmark index returns (Artikis et al. 2004). If the value of alpha is positive or greater than zero it means the fund is outperformed than its benchmark index and if the value is negative then the fund is underperformed than its benchmark index. Positive Alpha value determines the good performance of the fund manager. In this research paper, we have calculated alpha values of each fund for 15 years annually and evaluated the excess returns with respect to benchmark index [43][44].
- 3.4 Beta:** Beta is measure to calculate the volatility of a particular fund. It is the measure of relative risk with respect to benchmark index. However, the value doesn’t calculate the inherent risk of assets in the fund. A beta value greater than 1 means that the fund is more volatile or riskier than the benchmark index; whereas a beta value less than 1 means the fund is less volatile and riskier than the index (Bhagyashree et al. 2016).. In this research paper, we have calculated annual beta value of each fund to gauge its relative index volatility in last 15 years.
- 3.5 Treynor Ratio:** Treynor’s Ratio is developed by Jack Treynor in 1965 which include only systematic risk component. This ratio considers market risk such as  $\beta$  while calculation (Gusni et al. 20018). The ratio is computed by adjusts excess return for the systematic risk that is  $\beta$  (beta). This ratio measures the efficiency of the fund manager with which he/she allocates the fund’s assets to compensate the investor for taking the given level of risk. This indicates return per unit of market risk. When the portfolio is well diversified then this ratio is used to measure the return. The ratio is denoted by T and is given as:

$$T = \frac{R_p - R_f}{\beta_p} \tag{1}$$

Where,

$R_p$  = Portfolio rate of return during a specified period

$R_f$  = Risk-free rate of return during the same period

$\beta_p$  = Beta of the fund

**3.6 Sharpe Ratio:** This ratio indicates excessive return of a mutual fund with respect to volatility to gauge risk adjusted performance. Volatility is defined by Standard deviation of the portfolio return (Hao 2010). For ranking the funds, both the Sharpe and Treynor ratio uses same information of return but not the risk component. While Sharpe ratio takes the total risk in form of standard deviation, Treynor ratio takes the market risk only in form of Beta. The Sharpe's measure of performance denoted by S is given as [45][46].

$$S = \frac{R_p - R_f}{\sigma_p} \tag{2}$$

Where,

$R_p$  = Portfolio rate of return during a specified period

$R_f$  = Risk-free rate of return during the same period

$\sigma_p$  = Standard deviation of the portfolio return

**3.7 Jensen Ratio:** This ratio is a measure of the fund return in excess of theoretical expected return. It indicates whether the fund manager has performed better or worse than expected return for a given market risk defined by Beta (Thomyamongkol et al. 2020). Generally, higher the risk, higher is the expected return from the fund. This ratio is the extended version of the standard alpha based on theoretical performance instead of market index. It evaluates the overall return of the fund over the benchmark index. Higher the value of Jansen alpha, Better is the performance of the fund and in this research paper, we have calculated annual values of each fund to compare their performance. Jensen's measure of performance is denoted by  $\alpha$  and is given as:

$$\alpha = (R_p - R_f) - \beta_p(R_m - R_f) \tag{3}$$

Where,

$\alpha$  = Jensen Measure (Alpha)

$R_p$  = Portfolio rate of return during a specified period

$R_f$  = Risk-free rate of return during the same period

$\beta_p$  = Beta of the fund

$R_m$  = Market Return

**3.8 Maximum drawdown (MDD) during the fund tenure:** A maximum drawdown (MDD) is the maximum observed loss from a peak value during the fund evaluation period. This MDD value is compared with funds in same or different category to check, how resilient the fund is, during the bear cycle. Higher MDD denotes the fund historically has been more risky and we have compared it with benchmark index's MDD. This factor gauged in percentage terms the maximum drawdown in fund from its high during last 15 years.

**3.9 Maximum Recoup Time (MCT):** The maximum Recoup Time is defined as maximum duration (in years) taken by fund to reach back its high and regain its lost value. This primarily defines the time an investor could have remained in loss even if he has invested in fund at its high value. This factor is an indicator of funds resilience and activeness. Lower the Value of MCT indicates a better performance of a fund. In this research paper, MCT value is calculated from 2007 to 2021.

#### 4. METHODOLOGY

In this research work, a lot of mutual funds are explored and analysed by different fields to get top 5 large cap equity mutual fund. After explore all the fields of different large cap equity mutual funds, these 5 funds are selected for this process:

- Franklin India Bluechip Fund Growth named as Frank

- HDFC Top 100 Fund Growth named as HDFC
- Kotak Bluechip Fund – Growth named as Kotak
- UTI Large Cap Fund named as UTI
- DSP Top 100 Equity Fund - Regular Plan – Growth named as DSP

These mutual funds performance has been evaluated from 2007 to 2021 to have a comprehensive period of bull and bear cycle and have considerable data to evaluate the funds. The data related to these five mutual funds is considered and NAV (Net Asset Value) data of these funds is taken from the government authorized website amfiindia (link). This data of NAV, related to these five mutual funds, is very huge in size, so the preprocessing techniques of data mining are applied to this whole NAV data. The preprocessing techniques (Abosova et al. 2018) like data integration, data cleaning and data normalization are applied to the whole raw NAV data. In data integration technique, the data related to each mutual fund is integrated in one unified file to apply the data pre-processing on the whole NAV data related to five mutual funds. After data integration, data cleaning is applied to that unified file. In data cleaning, missing values are checked and evaluated with the help of different methods. After exploring all methods, interpolation method is selected to handle the missing values in that NAV data (Sessa et al. 2016). After handling the missing values, the data is very clear to use for research proposes. But the NAV data of all funds are on widely different scales. Their range of input data is quite different from each other. So, data normalization is applied on the NAV data to transform into specific format (Pan et al. 2016). After analyze all the normalization techniques, min-max normalization is applied to the NAV data and transform the data into new range of values [0, 1]. After applied the all the data pre-processing techniques, NAV data is analyzed by different data mining techniques (Han et al. 2006) and the results are evaluated by SPSS tool.

## 5. RESULTS AND DISCUSSION

The analysis is performed using various methods discussed where different factors are computed by using pre-processed NAV data of all mutual funds and evaluated against Benchmark Index i.e. NIFTY.

The result of all these factors are analyzed by using different data mining techniques and these results are discussed as follows:

**5.1 Compound Annual Growth Rate (CAGR):** - CAGR denotes compounded annualized growth rate of investments, assuming that profits were reinvested at the end of every year. CAGR of funds' performance was analysed over 4 time periods (3 years, 5 years, 10 years and 15 years) to gauge its longevity & stability and benchmark it with the Nifty CAGR returns. Since, risk profile is different for the type of fund, we have analysed the CAGR value for large cap fund. Top 5 funds were selected and CAGR value was plotted for time periods as described above. While evaluating the performance of these funds, UTI Large Cap fund is constantly beating nifty's CAGR return, for each time intervals selected. Although, it's not a highest return generating fund but has been a consistent compounder. It has shown maximum outperformance over longer time durations. Kotak has been closed second but it has generated highest CAGR returns amongst the selected funds for maximum no of times. HDFC on other hand, hand a subdued performance recently with below par performance in 3 year & 5 year period.

Table 1: CAGR return of Large Cap Funds

Fund name	UTI	KOTAK	DSP	FRANK	HDFC	NIFTY
3 Yr. CAGR	9.48%	10.18%	6.91%	7.99%	4.40%	7.98%
5 Yr. CAGR	9.80%	9.70%	7.11%	7.78%	7.21%	9.72%
10 Yr. CAGR	12.00%	12.43%	9.74%	10.79%	10.99%	10.70%
15 Yr. CAGR	10.63%	10.83%	10.77%	10.85%	11.65%	9.43%

\*Funds beating NIFTY Returns are marked in Green

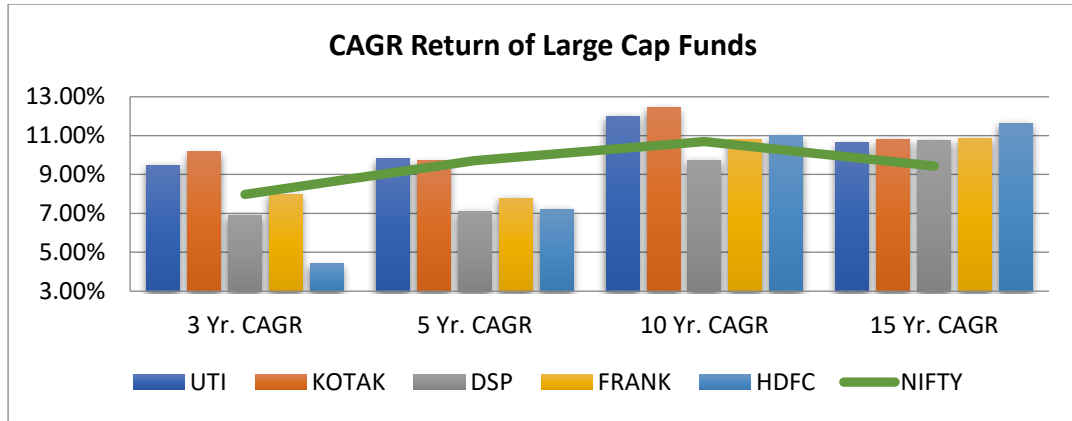


Fig.1: CAGR return of Large Cap Funds

**5.2 Extended Rate of return (XIRR):** XIRR determines actual returns to investors in case the investor has multiple inflows and outflows of investment. We have evaluated XIRR of each fund assuming investor has deposited same amount of money each time, the NAV of Mutual fund has fallen by 1% or more in a day. XIRR was in range of 11 to 13% for the funds. HDFC generated the slightly higher XIRR compared to others whereas DSP generated the lowest XIRR.

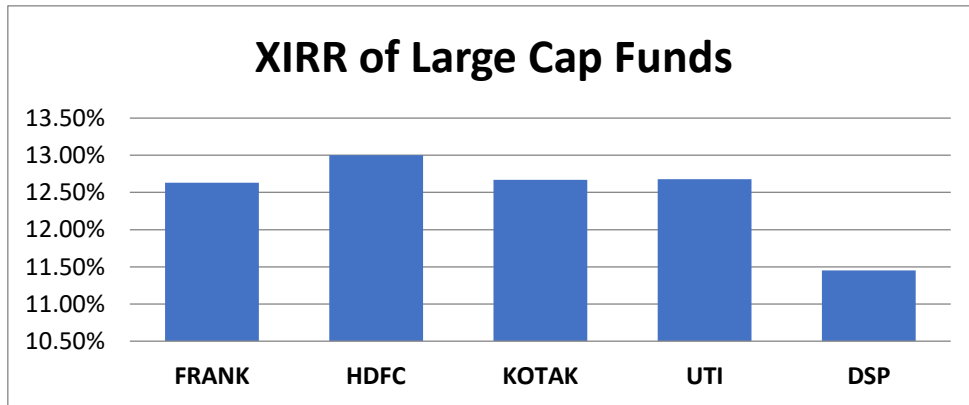


Fig.2: XIRR of Large Cap Funds

**5.3 Alpha:** - Alpha is the Fund Managers additional performance than its benchmark peer. Portfolio managers seek to generate alpha for their fund to reward their shareholders. We analyzed each selected fund for last 15 years and analyzed the outperformance in form of positive value of alpha. Alpha value of UTI fund has remained positive for 9 years out of last 15 years. This fund has shown considerable resistance over the market whereas HDFC has been again close second but has generated maximum alpha during bull cycle.

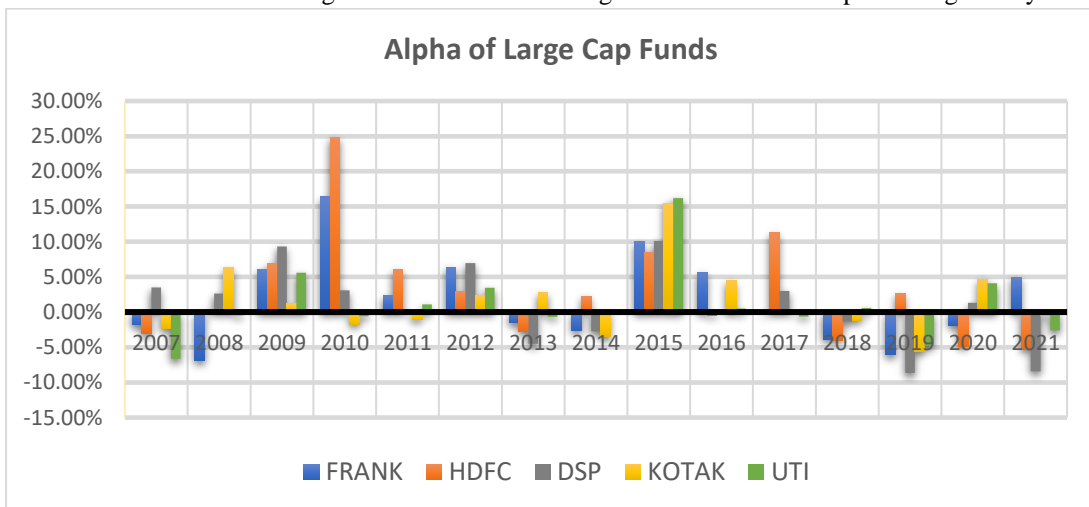


Fig.3: Alpha of Large Cap Funds

**5.4 Beta:** - Beta value is measure of market risk relative to the benchmark index. A higher value of beta signifies higher fluctuations and risk and should be compensated with higher returns in a well managed fund. The baseline for the beta value is 1. If the value of beta is 1, it means the funds is shown equivalent variations that of the market. We compared beta value of funds for last 15 years and concluded UTI fund and Frank fund has kept beta less than 1 throughout the time period and hence had lower market risk whereas HDFC fund has been most volatile and had higher market risk compared to all other funds.

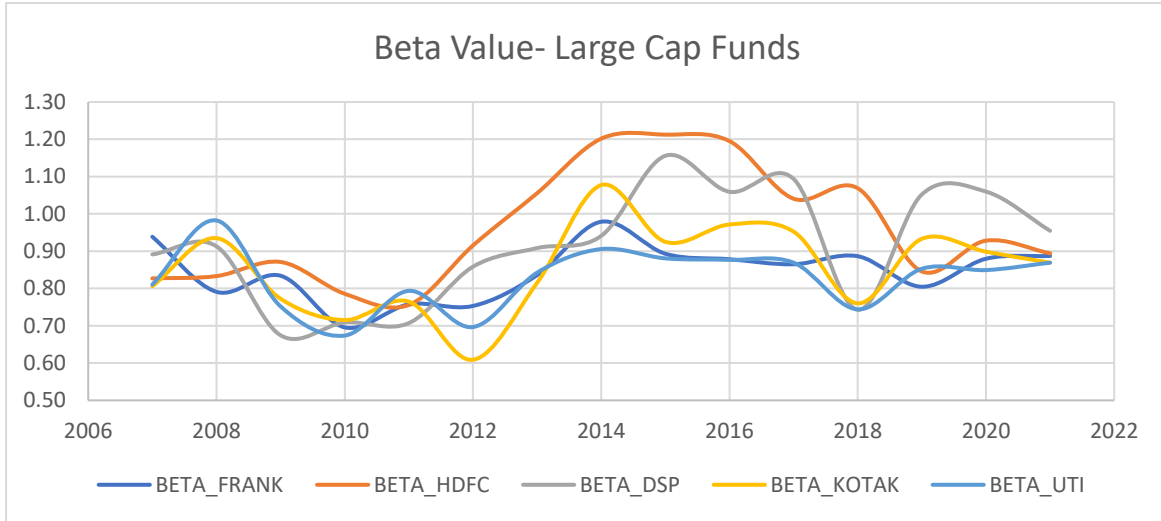


Fig.4: Beta of Large Cap Funds

**5.5 Treynor’s Ratio:** - Treynor ratio is a measure of the returns earned more than the risk-free return at a given level of market risk. This ratio is used to compare different mutual fund schemes on risk-adjusted parameters. This ratio scales the efficiency of the fund manager to balance between the return and risk of the portfolio. Treynor ratio can only be applied to well-diversified portfolios because market Risk is non-diversifiable whereas Sharpe Ratio can be applied to all kinds of portfolios. We analyzed the range of Treynor ratio of funds for the period and observed that HDFC and Frank fund had slighter better Treynor ratio compared to others with higher high and lower low. We also analyzed Treynor ratio of funds during two major bear cycles of Sub Prime Crisis and Covid and then their subsequent recovery. During the Sub Prime Crisis of 2009 & recovery thereafter, HDFC & Frank fared very well as explained above. However, Kotak has been more impressive during Covid period.

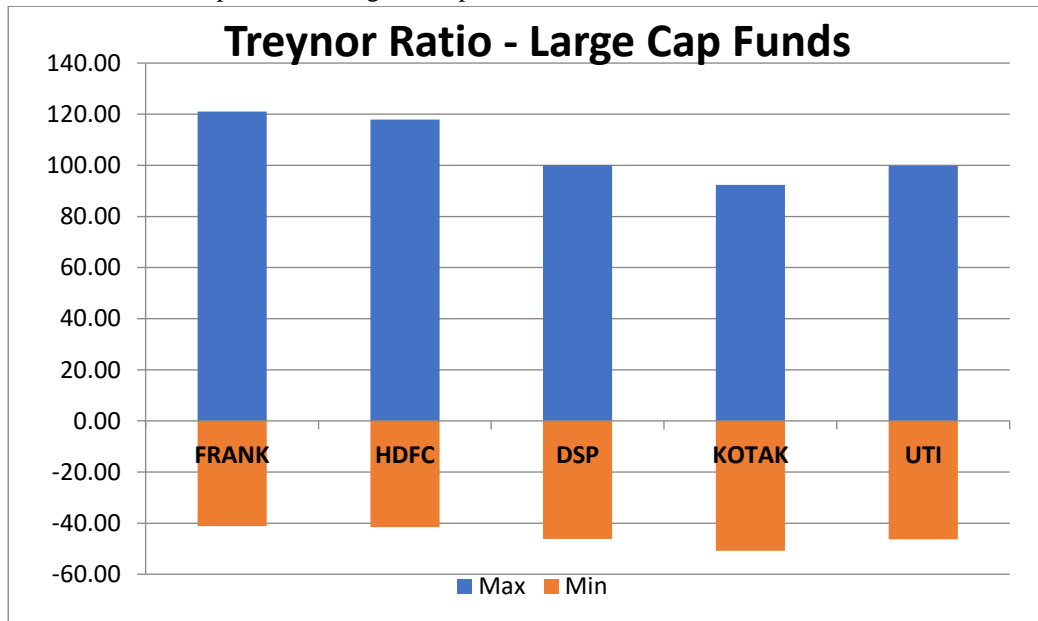


Fig.5: Treynor Ratio of Large Cap Funds  
Table.2: Treynor Ratio of Large Cap Funds

	Year	Frank	HDFC	DSP	Kotak	UTI
Sub Prime Crisis	2008	19.94	27.69	27.75	30.97	22.62
	2009	-41.14	-38.46	-46.13	-50.83	-46.33
	2010	121.07	117.95	100.11	92.40	99.82
Covid	2020	-40.43	-41.50	-30.52	-32.29	-34.82
	2021	89.00	76.86	68.70	84.51	82.13

**5.6 Sharpe Ratio:** -Sharpe Ratio is measure of excess returns generated by fund manager compared to risk free returns along with associated risk measured in form of standard deviation. Sharpe Ratio greater than 3 is considered good and less than 1 is consider poor. We compared range of Sharpe ratio of all funds and also evaluated the period where this ratio lies in good and poor zones. Performance of all funds in these years is almost at par. However, HDFC showed a slight edge in Sharpe ratio as it has lowest presence in poor zone. UTI showed highest Shape ratio for the study period.

Table.3: Sharpe Ratio of Large Cap Funds

Metrics	Frank	HDFC	DSP	Kotak	UTI
Max Sharpe Ratio in Last 15 years	10.66	10.35	8.87	8.25	11.18
Min Sharpe Ratio in Last 15 years	-4.39	-4.50	-3.60	-3.75	-4.56
Sharpe Ratio>3 in last 15 years(in No.)	4.00	4.00	4.00	5.00	4.00
Sharpe Ratio<1 in last 15 years(in No.)	8.00	7.00	8.00	8.00	8.00

**5.7 Jensen Ratio:** Jensen Ratio is measure of excess expected returns that portfolio manager has generated compared to risks associated with the fund. Higher Jensen ratio is good indicator of higher performance of fund manager. We analyzed Jensen ratio of funds in last 15 years and compared fund on two parameters. First one was the range of Jensen ratio which can demonstrate highs and lows of funds as expected performance and second was to count years when this ratio was positive. HDFC has been a performed exceptionally well here with positive Jensen ratio in Last 15 years and highest Jensen ratio as well. UTI has performed below par with only 7 positive counts and low range on Jensen ratio.

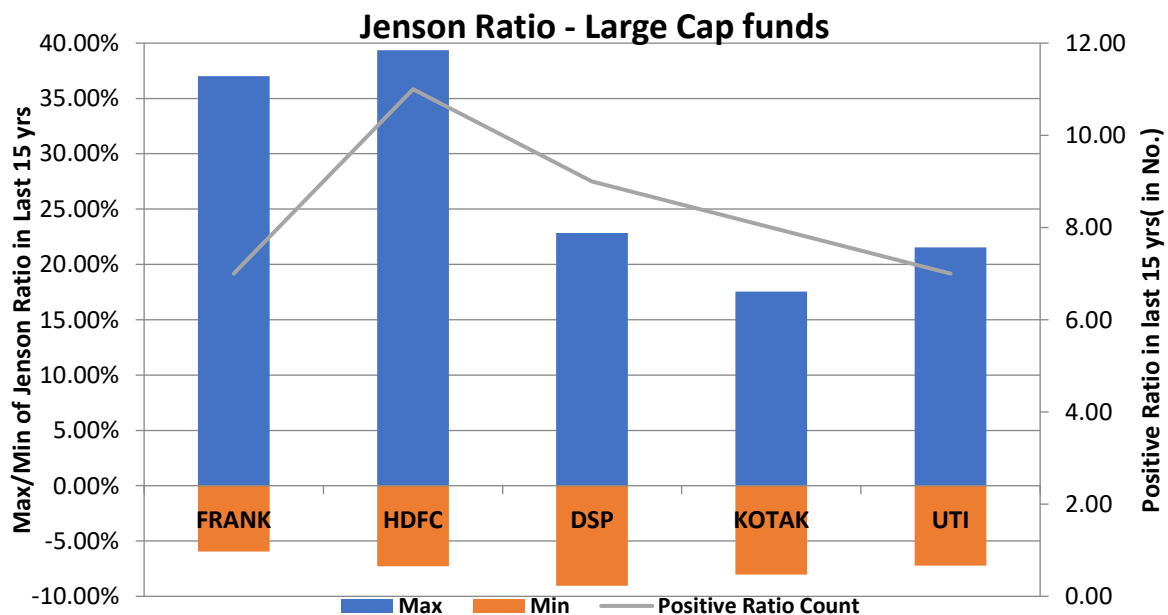


Fig 6: Jenson Ratio of Large Cap Funds

**5.8 Maximum Drawdown(Maximum Drawdown):** -Maximum drawdown in each of the selected fund was analyzed for last 15 years to study the effect of market fall on fund’s NAV during the down times. This helps to identify not only volatility of the fund but also resilience of the fund to hold its value during the bear cycles. As shown in chart below, DSP fund has shown minimum drawdown during the period whereas Kotak has the highest drawdown. Range however, all the funds have been between 50 – 58% that is faced during the subprime crisis of 2008.

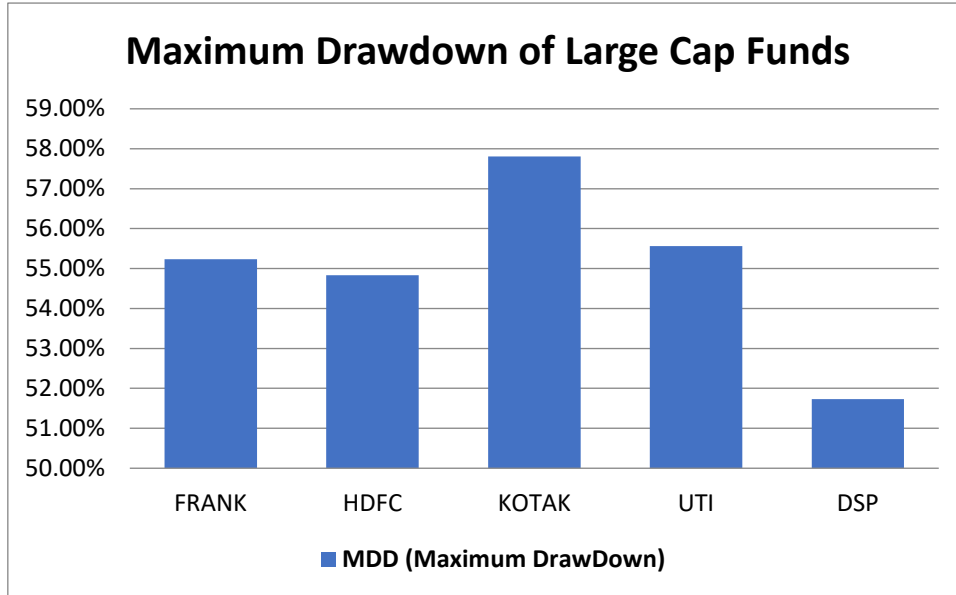


Fig 7: Maximum Drawdown of Large Cap Funds

**5.9 Maximum Recoup time:** -Maximum Recoup time identifies the maximum time taken by a fund to regain the lost value of NAV. Each fall in Funds, NAV prices were analyzed and recoup time was calculated and amongst all, maximum recoup time was calculated. It is generally studied in tandem with MDD. It determines the pro activeness of funds manager and his abilities to cover losses of shareholders. As per table below, Kotak took maximum time of almost 4.5 years to cover losses suffered during Sub Prime Crisis. Frank took the minimum time followed by UTI fund. However, recoup time when compared for Covid crisis has been at almost par for all the funds between 6 months to 1 year.

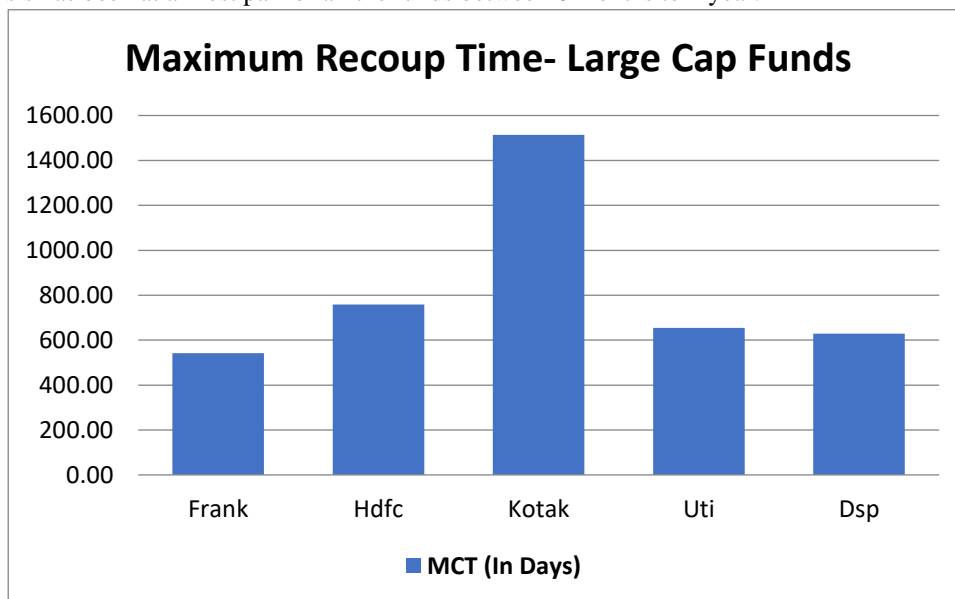


Fig 8: Maximum Recoup Time of Large Cap Funds

## 6. CONCLUSION

This research paper aims to statistically assess the performance of equity mutual funds across three main parameters: Overall Returns, Risk Adjusted Returns, and Resilience. In terms of return parameters, UTI fund demonstrates consistent and higher returns with lower market risk, making it suitable for risk-averse investors, while HDFC exhibits higher alpha and returns but carries more market risk, and DSP lags behind. Regarding risk-adjusted performance, HDFC outperforms peers when considering expected returns relative to market risk, although Kotak and Frank have shown improvement over time, particularly during the COVID period, surpassing HDFC in risk-adjusted returns. In terms of resilience, DSP emerges as the most resilient with the lowest drawdown and recoup time, while Kotak performs poorly with the highest drawdown and recoup time. Overall, HDFC demonstrates better performance for long-term and risk-taking investors, while UTI suits long-term risk-averse investors. Kotak performs well in the short term, especially during the COVID period. Future research could expand this evaluation to other categories of equity mutual funds, considering different crises such as wartime or political changes in various countries.

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