DEPARTMENT OF STATISTICS

Mutual fund portfolios and making investment decisions

Presented by :

- Kunal Salunkhe [M.Sc. Applied Statistics | 10]
- Nisha Lad [M.Sc. Applied Statistics | 12]

Project Guide : Prof. (Dr). Jyoti Divecha

CONTENTS

Objective

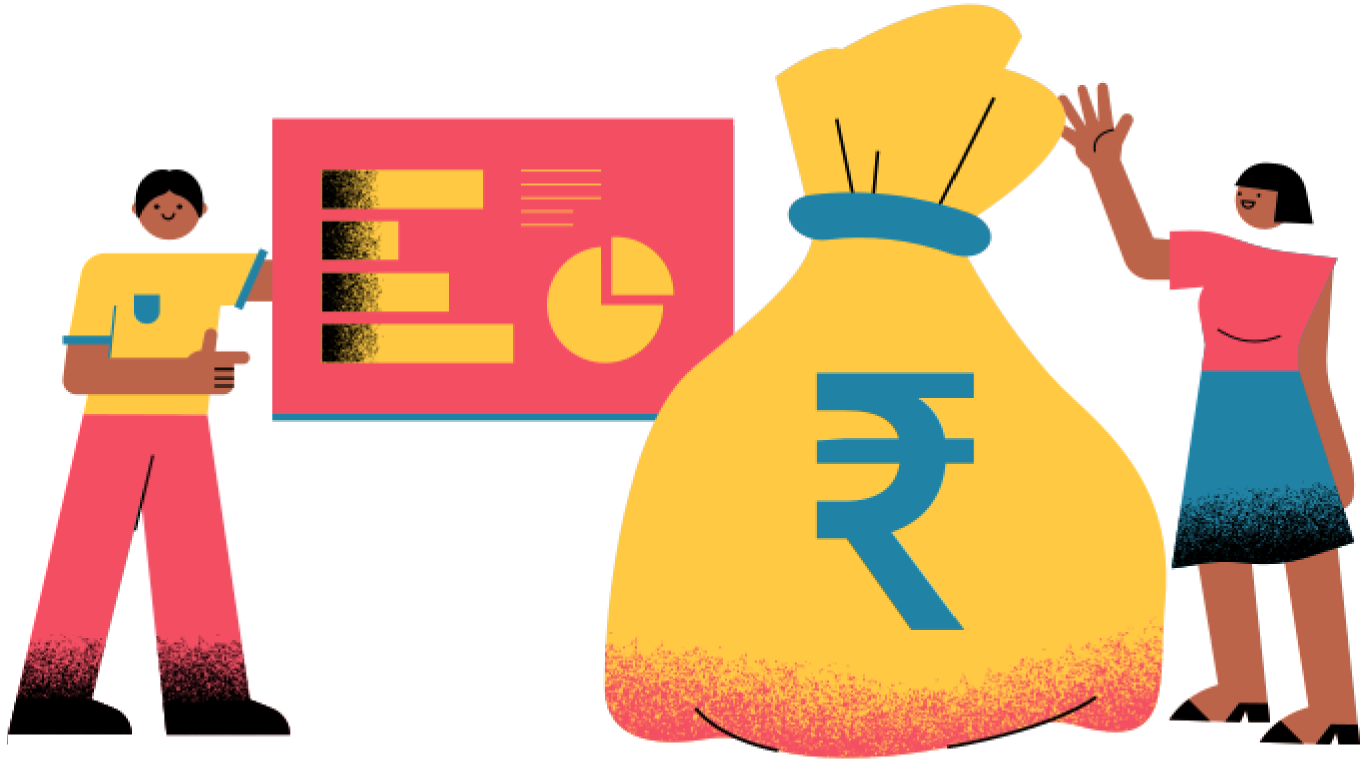
- 1) Explore factors influencing the performance of mutual funds, such as economic indicators, interest rates, and market conditions.
- 2) Analyze the risk-return trade-off for different mutual fund portfolios.
- 3) To identify the best mutual fund portfolio of securities.
- 4) To help the investors to decide the effective mutual fund portfolio of securities.

Introduction

A mutual fund is a type of investment vehicle consisting of a portfolio of stocks, bonds, or other securities. A mutual fund is a financial vehicle that pools assets from shareholders to invest in securities like stocks, bonds, money market instruments, and other assets. Mutual funds are operated by professional money managers, who allocate the fund's assets and attempt to produce capital gains or income for the fund's investors.

Mutual funds give small or individual investors access to professionally managed portfolios of equities, bonds, and other securities. Each shareholder, therefore, participates proportionally in the gains or losses of the fund.

Need For the Study



We are doing this project to learn all about mutual funds - how they work and how they've changed over time. We also want to see what the future might hold for mutual funds. By looking closely at different types of mutual fund investments, we are trying to figure out which ones are the best.

This research is helping us understand investment options better, so we can make smarter financial decisions.

Data Description

(Observations-814 and Variables-20 | [Click Here For Data File in CSV Format]

Source of Data : https://www.kaggle.com/datasets/ravibarnawal/mutual-funds-india-detailed

Variables:

Scheme_name: Name of the mutual fund scheme

min_sip (Systematic Investment Plan): When you set aside a small amount of money to invest in mutual fund.

min_lumpsum: Min amount 5000 required to start. Lumpsum means putting large amount of money into the fund all at onces.

expense_ratio: Think of expense ratio as fee you pay each year for investing in mutual fund. and it is calculated as a percentage

$$expense\_ratio : \frac{Management\ Fees}{Total\ Investment\ in\ the\ fund}$$

Data Description

Variable:

- **fund_size_cr:** the total amount of money that a mutual fund manager must oversee and invest.
- **fund_age_yr:** years since inception of scheme
- **fund_manager:** A fund manager is responsible for implementing a fund's investment strategy and managing its trading activities.
- **Sortino:** Sortino ratio measures the risk-adjusted performance as it means the investment or portfolio is generating more return for downside risk taken. Investor generally prefer higher sortino ratio.

$$Sortino: \frac{RP - RF}{\sigma d}$$

where, RP= portfolio return, RF= risk free rate,
σd= downside standard deviation

Data Description

Variable:

- **Alpha:** Alpha is the risk adjustive measure of how a security in comparison to the overall market average return. High alpha indicate better performance for fund.

  Alpha : Expected return of the market - Actual return fund manager generated

- **SD:** A standard deviation is a number that can be used to show how much the returns of a mutual fund scheme are likely to deviate from its average annual returns. Low SD indicate lower volatility for the fund.

$$Sd = \frac{\sqrt{\Sigma(X-\bar{x})^2}}{n-1}$$

Where, X = The Yearly mutual fund returns (Investment returns), $\bar{x}$ = *Average Return*, n = Total number of observations

- **Beta:** Beta in a mutual fund is often used beta less than 1 indicate lower volatility for the fund.Beta ratio more than 1 indicate more volatility for the fund.

$$\text{Beta}: \frac{\text{Fund return} - \text{Risk free rate}}{\textit{Benchmark return} - \textit{Risk free rate}}$$

Data Description

Variable:

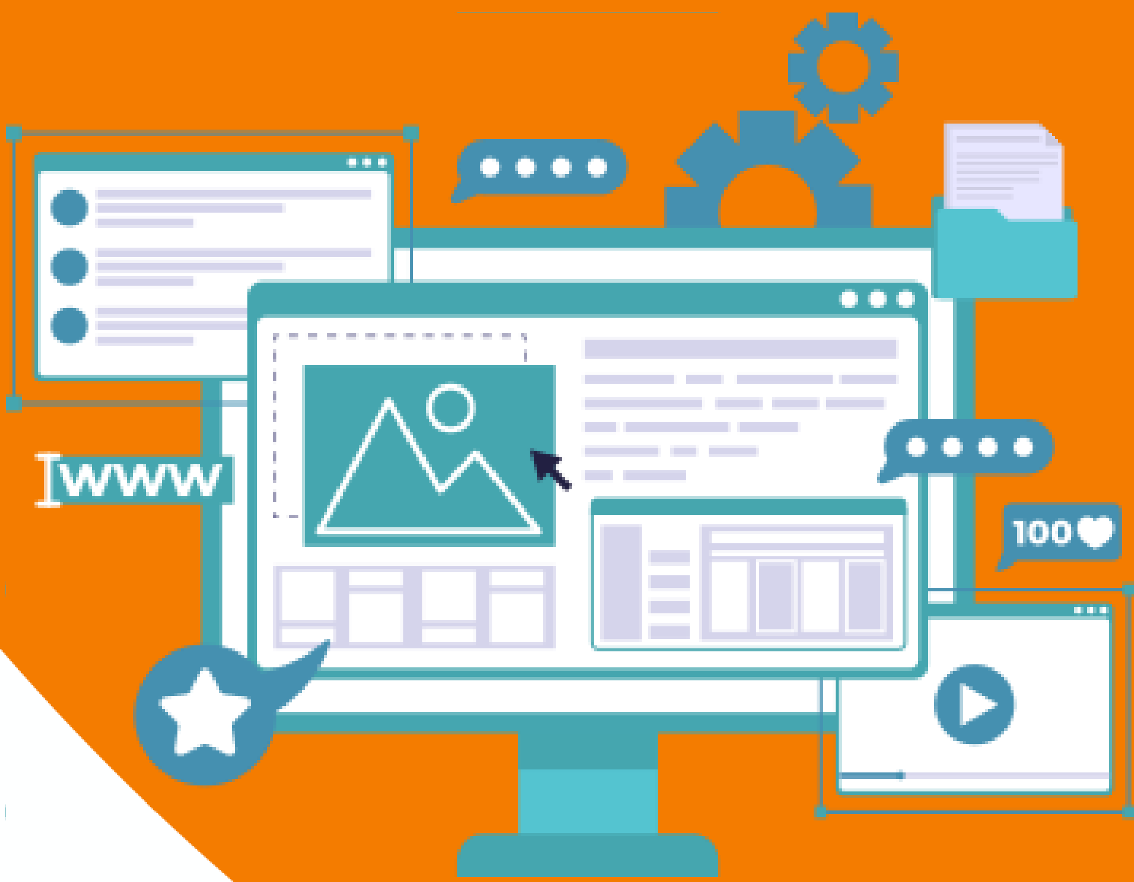
Sharpe: Sharpe Ratio of a mutual fund reveals its potential risk-adjusted returns

$$Sharpe: \frac{Rp - RF}{\sigma d}$$

where, Rp= average rate of return, RF= the best available rate of return of risk free security, σd= standard deviation

- **risk_level:** 1- Low risk,2- Low to moderate,3- Moderate,4- Moderately High,5- High,6- Very High
- **amc_name:** Mutual fund house managing the assets.
- **Rating:** 0-5 rating assigned to scheme
- **Category:** The category to which the mutual fund belongs (e.g. equity, debt, hybrid)
- **sub_category:** It includes category like Childrens Funds, FoFs Domestic, etc.
- **returns_1yr:** The return percentage of the mutual fund scheme over 1 year.
- **returns_3yr:** The return percentage of the mutual fund scheme over 3 year.
- **returns_5yr:** The return percentage of the mutual fund scheme over 5year.

Computing Aids



In our project, we'll use Python, Excel, R language and SPSS to make it visually understandable. These tools will help us analyze, present, and share insights effectively.

[Click Here : Python Code]

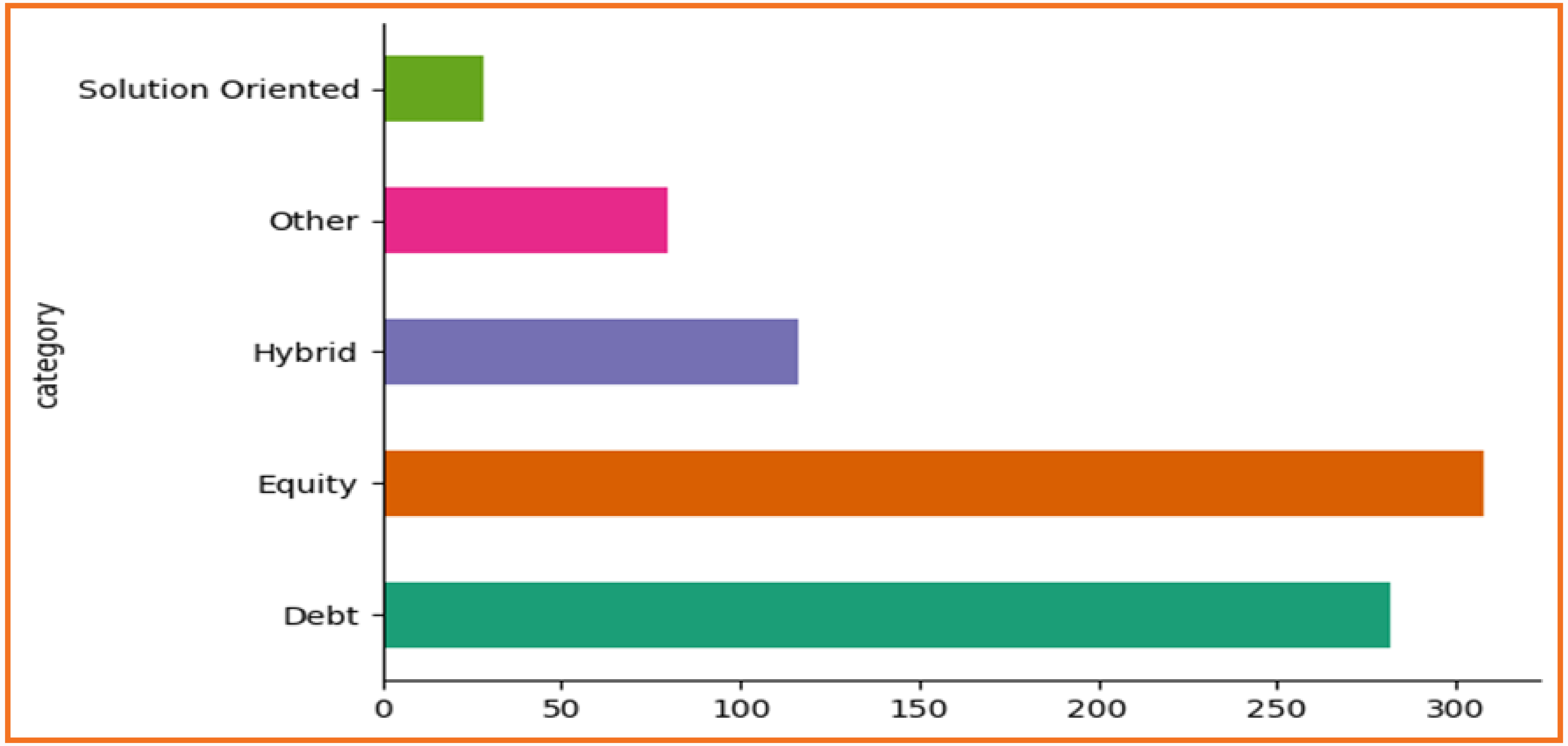
Python

Excel

R language

SPSS

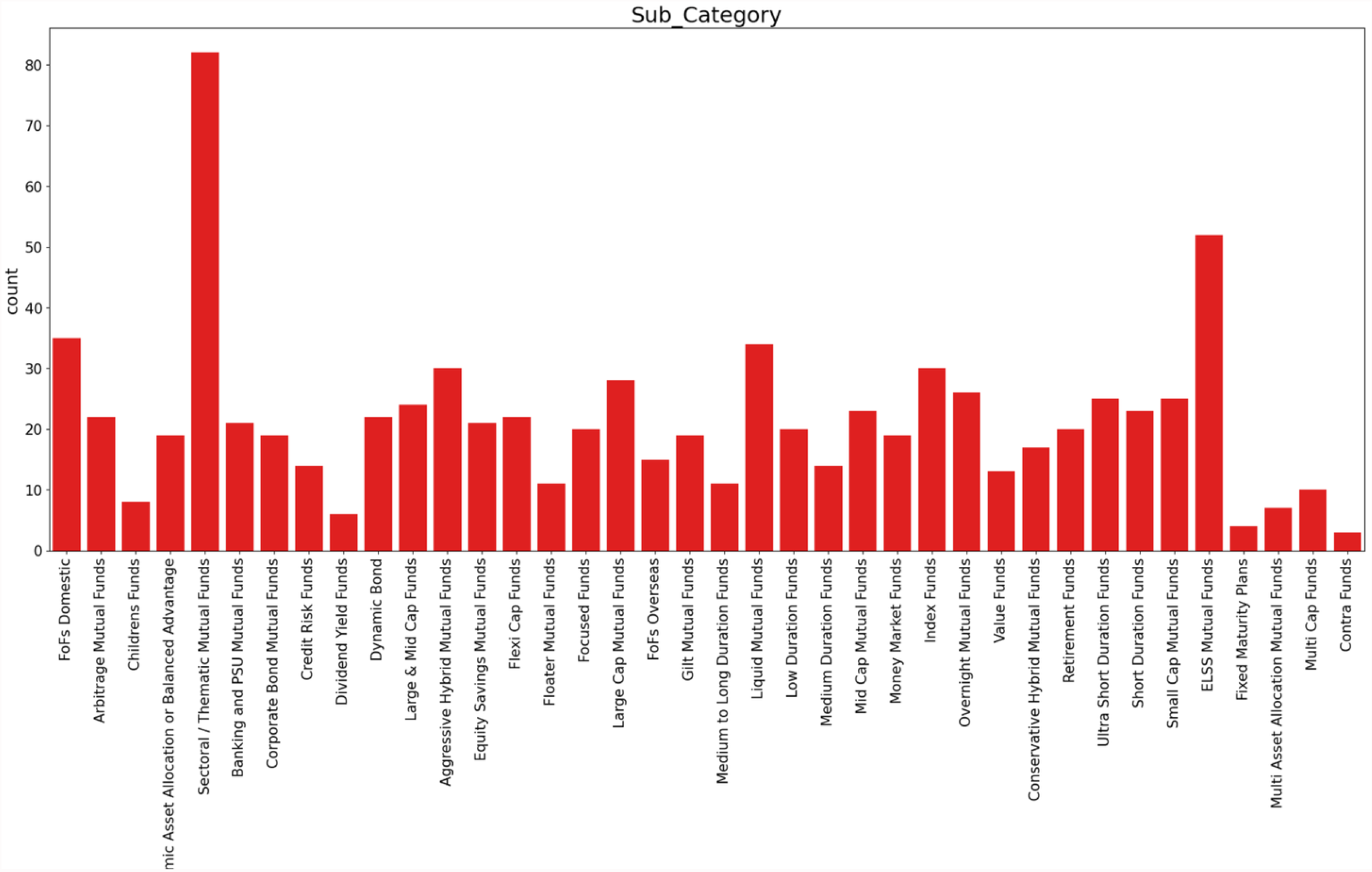
EDA



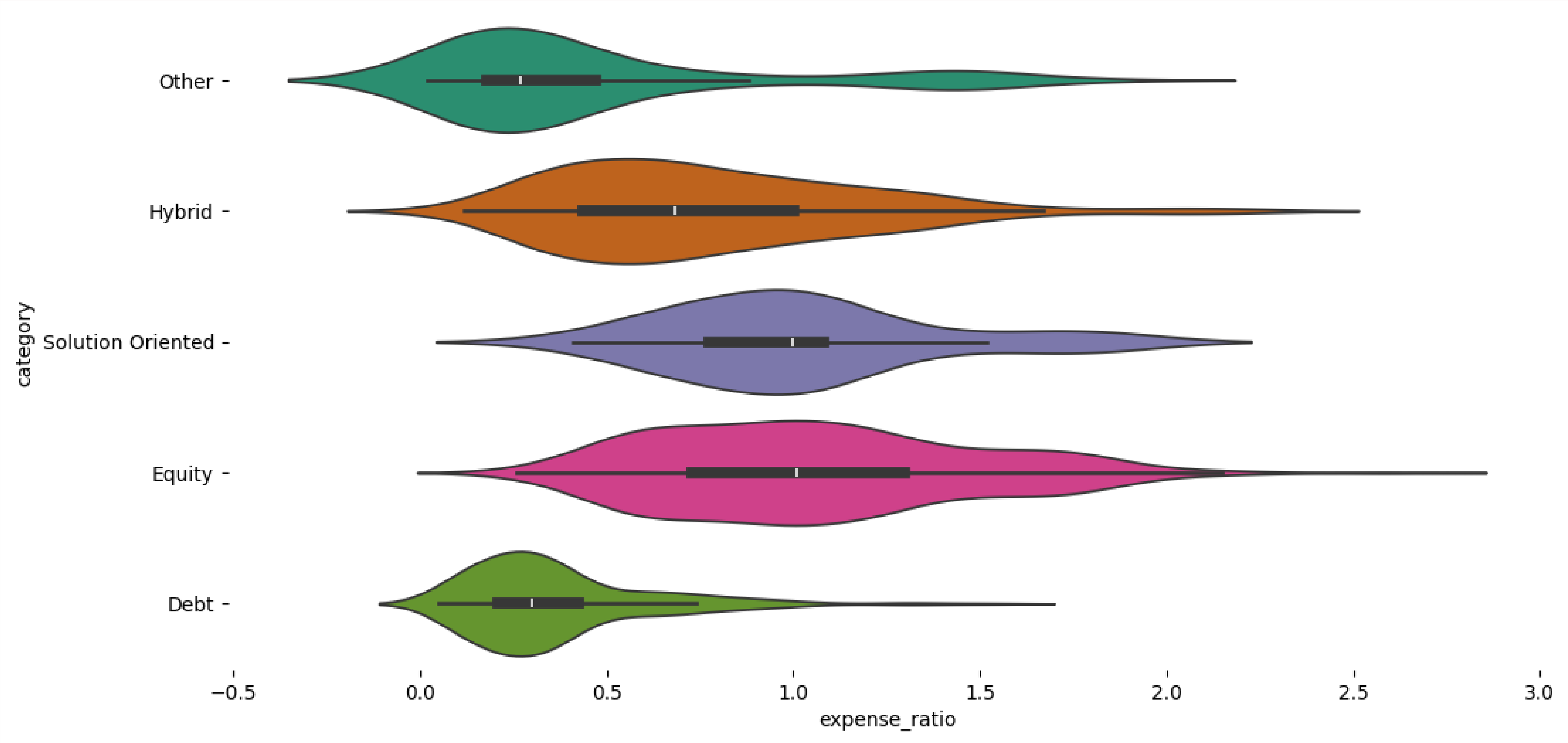
Number of MF Schemes Per Investment

Category Plot show :

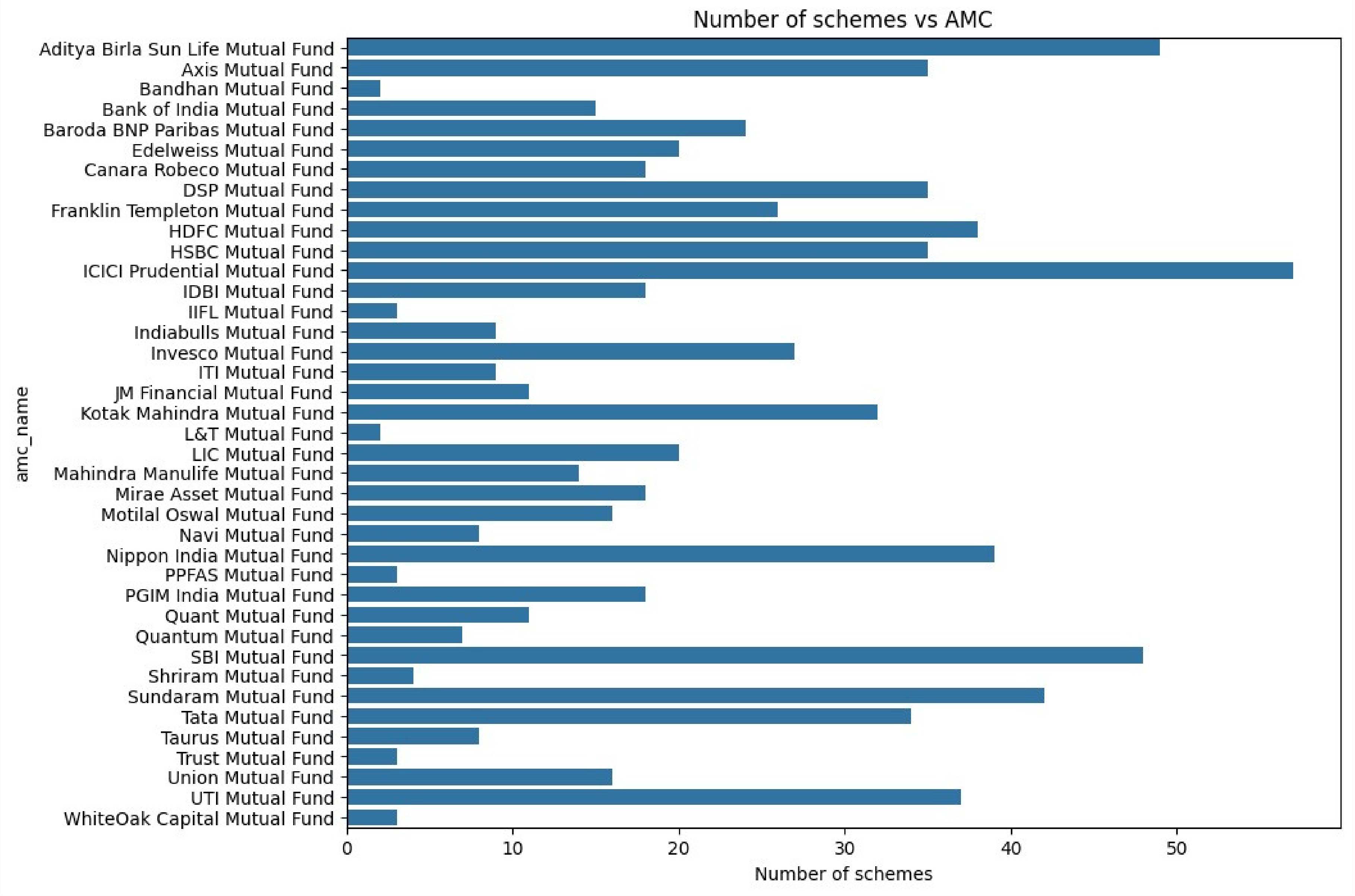
- **80 mutual fund in Other category**
- **116 mutual fund in Hybrid category**
- **28 mutual fund in Solution oriented category**
- **308 mutual fund in Equity category**
- **282 mutual fund in Debt category**



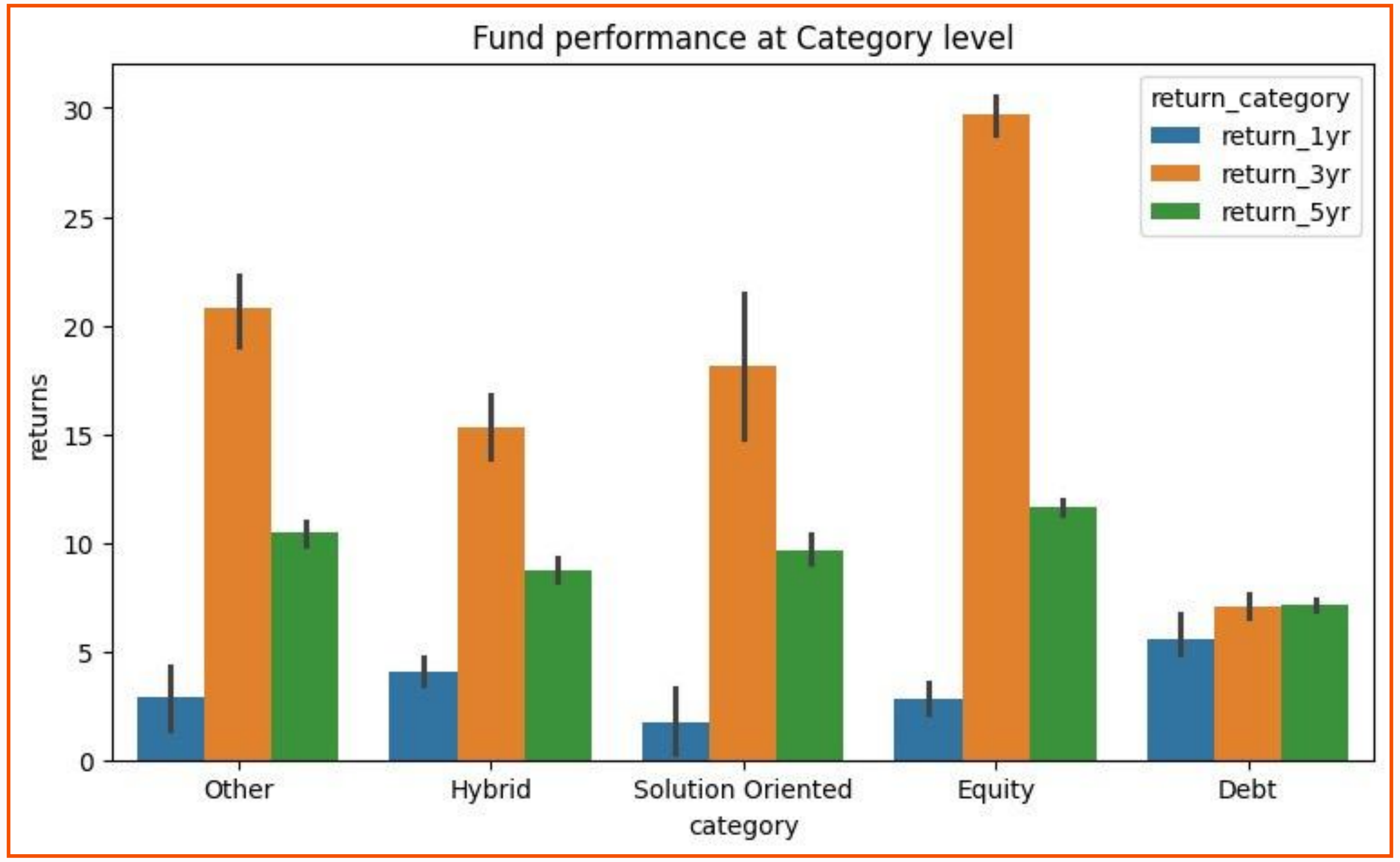
There are 38 sub-category of mutual fund in this plot can show sectoral/Thematic mutual fund has higher count than other mutual fund.

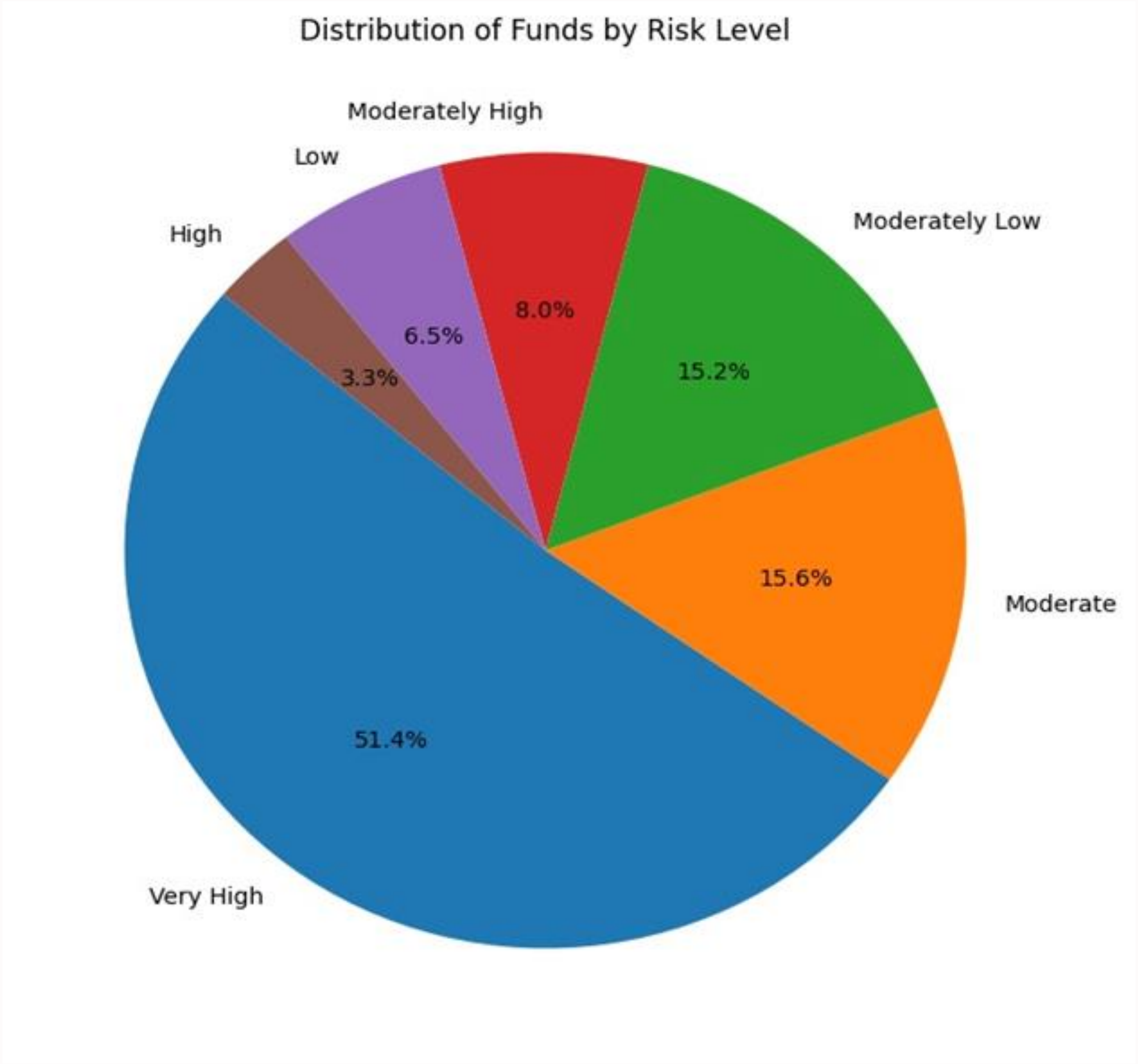


From this plot we can say that **Equity** has show high (2.59 %) **Expense Ratio**



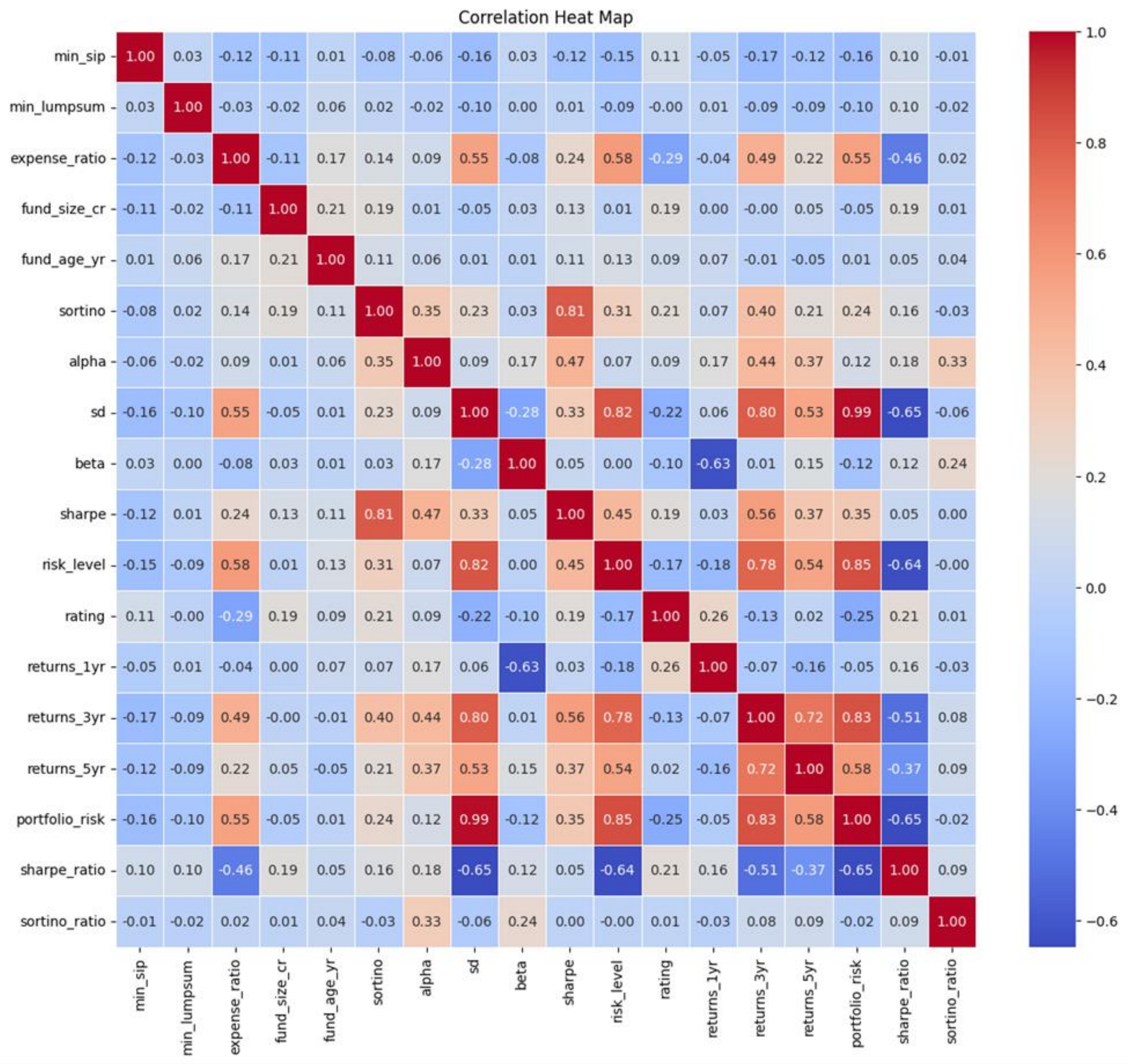
From this plot we can say that **ICICI Prudential Mutual Fund** has around 57 schemes running.

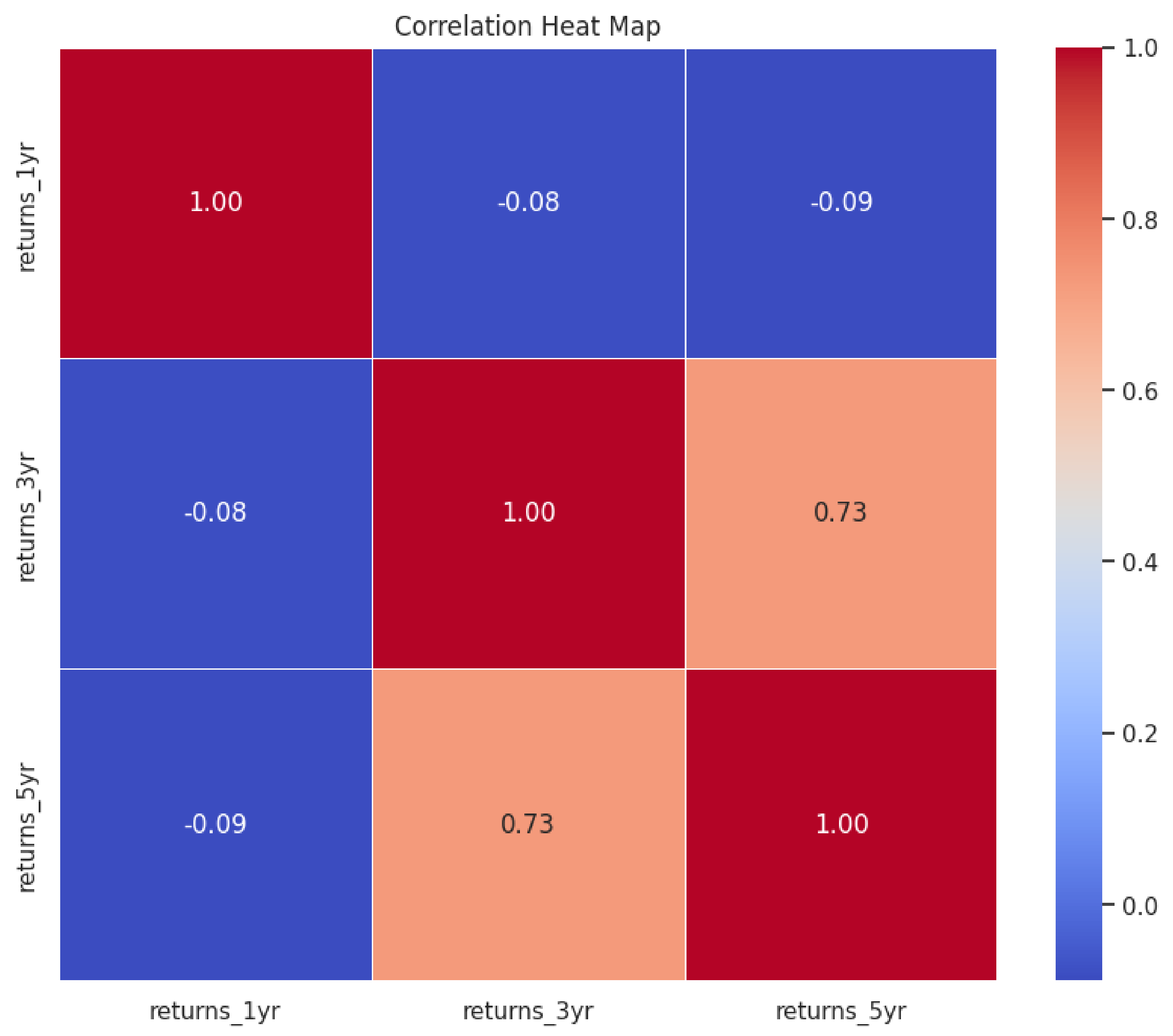




From the above chart, Equity category funds gives the highest returns as compared to other category.

Here most of the schemes have risk level Very High. i.e. 51.4%





- **Correlation heat map show that high correlation among standard deviation & portfolio_risk, returns_3yr**
- **Moderate correlation among standard deviation & risk_level, sortino & sharpe, returns_3yr & returns_5yr, returns_3yr & portfolio_risk, risk_level & portfolio_risk**

Here's a brief explanation of each formula:

- **Portfolio Risk:** The sum of standard deviation (sd) and beta for each investment in the portfolio. Standard deviation measures the volatility or dispersion of returns from the mean, while beta measures the sensitivity of an investment's returns to market movements. Adding these two measures provides an estimate of the overall risk of the portfolio.

  Portfolio Risk = Sd + Beta

- **Sharpe Ratio:** The ratio of excess return (return minus risk-free rate) to standard deviation. It measures the risk-adjusted return of an investment or portfolio. A higher Sharpe ratio indicates better risk-adjusted performance.

  Sharpe Ratio = alpha / Sd

- **Sortino Ratio:** Similar to the Sharpe ratio, but it only considers the downside risk, which is defined as the standard deviation of negative returns or returns below a certain threshold (e.g., risk-free rate or target return). It provides a measure of risk-adjusted return that focuses on minimizing downside risk.

  Sortino Ratio = alpha / Sortino

These formulas are commonly used to evaluate investment portfolios because they provide insights into both the performance and risk characteristics of the portfolio, helping investors make informed decisions about their investments.

	returns_1yr	returns_3yr	returns_5yr	portfolio_risk	sharpe_ratio	sortino_ratio
count	814.000000	814.000000	814.000000	814.000000	814.000000	814.000000
mean	3.921376	18.524693	9.490577	11.094742	0.837470	1.027999
std	6.675502	11.951072	3.310660	7.427464	1.230465	4.701076
min	-19.700000	3.300000	-4.100000	0.720000	-0.682274	-31.500000
25%	1.500000	6.300000	7.100000	3.350000	0.068552	0.234804
50%	4.400000	18.500000	9.490000	12.610000	0.306439	0.854545
75%	5.600000	27.000000	11.500000	17.257500	1.026287	1.531219
max	130.800000	71.400000	23.200000	45.860000	5.851852	115.000000

- In our data, high 1st year return 130% & low 1st year return -19%

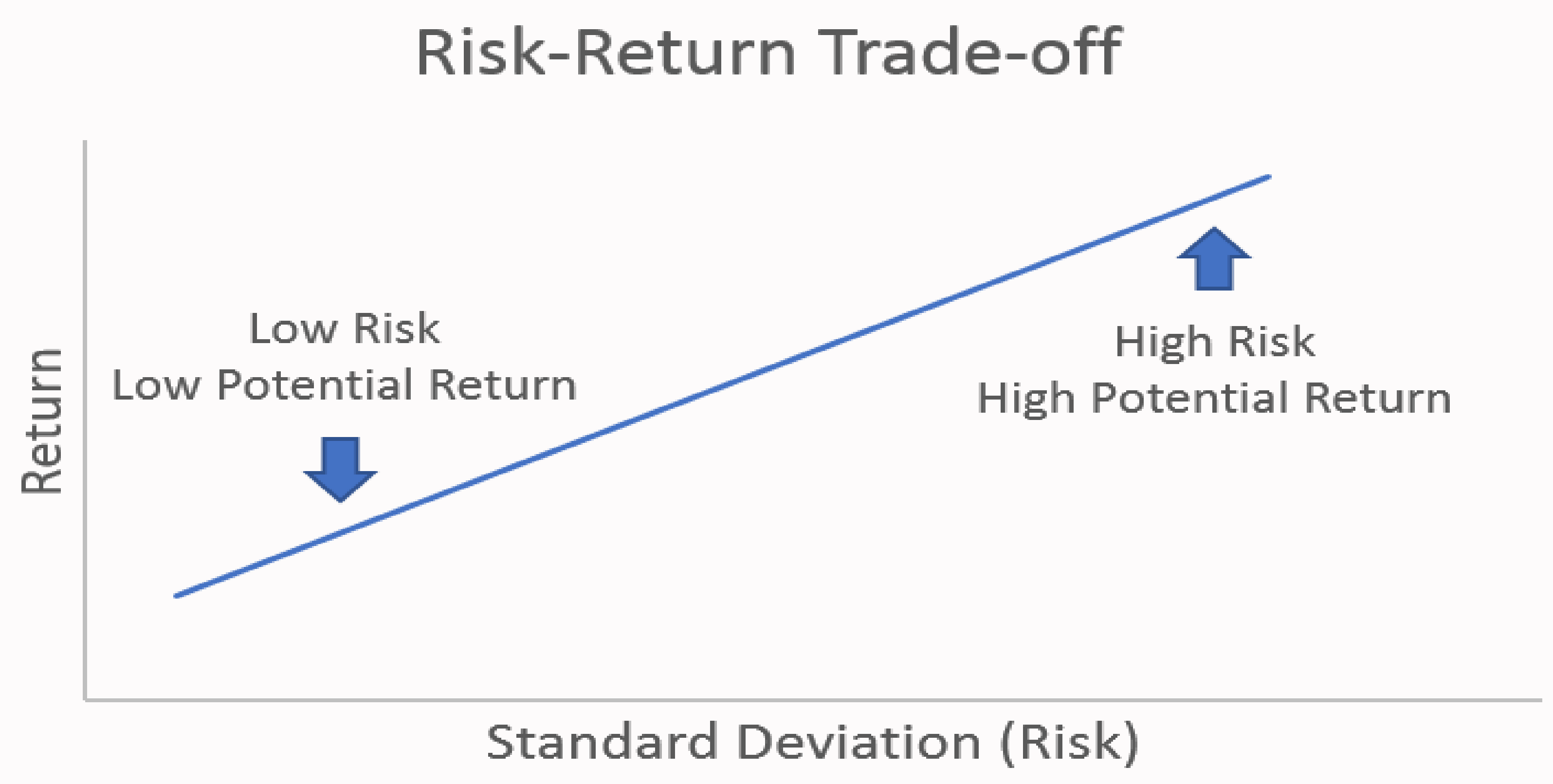
- If you want high return - high risk then sharpe ratio will be low
- When low risk - low return then then sharpe ratio will be high

- If market down & you want lower volatility & higher returns then we'll choose higher sortino ratio

(Reference : Disha Thakkar (ICICI Mutual Fund, Anand Gujarat))

Fundamental Principal Trade-off

The most fundamental principal of finance literature is that there is a trade-off between risk and return. The risk-return relationship requires that the return on a security should be commensurate with its riskiness. If the capital markets are operationally efficient, then all investment assets should be providing a rate or return that is consistent with the risks associated with them. The risk and return are directly variable, i.e. an investment with higher risk should produce higher return.

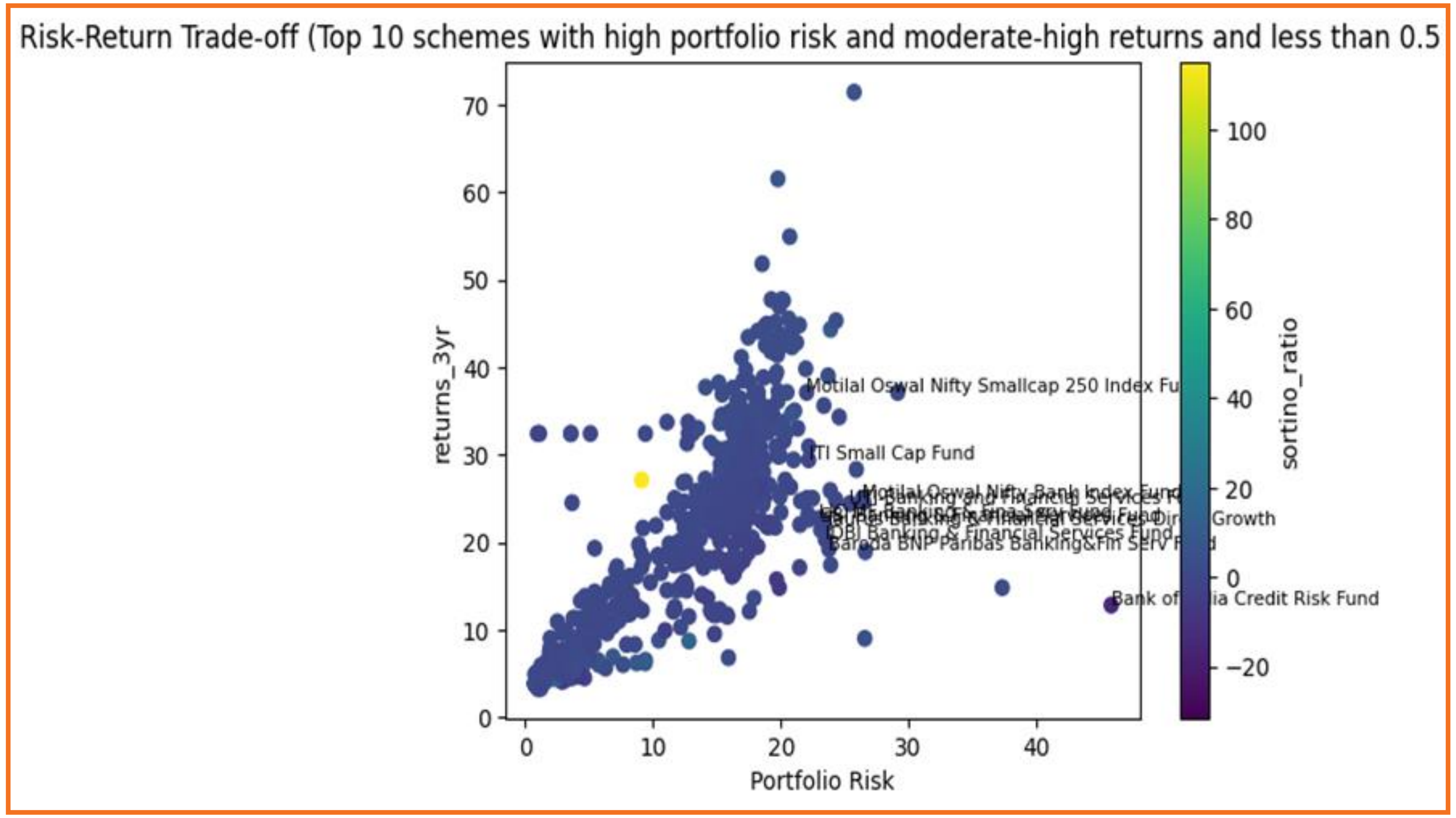


Low levels of uncertainty (low risk) are associated with low potential returns. High levels of uncertainty (High risk) are associated with highest potential returns. The risk/returns are the balance between desire for the lowest possible risk and the highest possible return.

The risk/return trade-off tells us that the highest risk gives us the possibility of higher returns. There are no guarantees just as risk means highest potential returns, it also means highest potential losses.

Fundamental Principal Trade-off

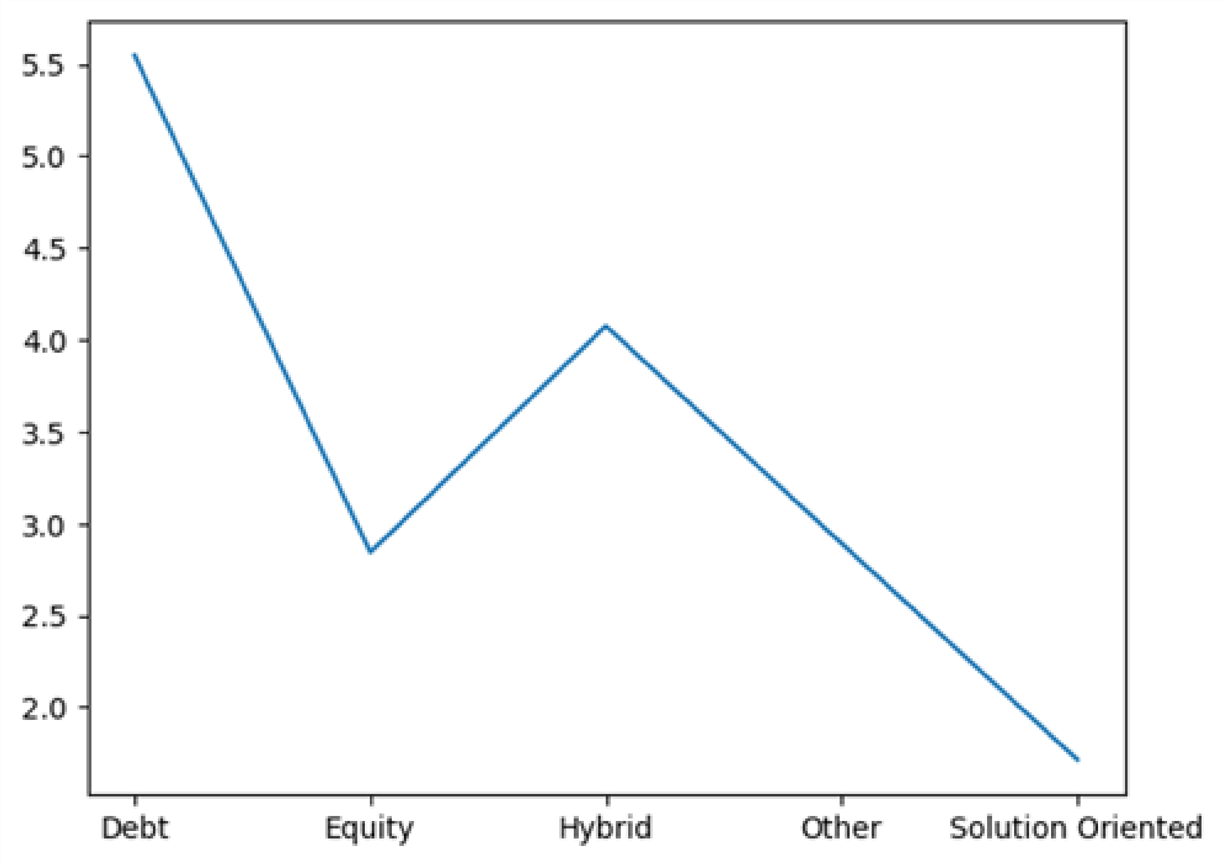
When Sharpe ratio & Sharpe ratio are low which is less than 0.5 then risk-return tread-off show high risk and moderate-high return. i.e. High risk & low return. Which can be dangerous for investors.



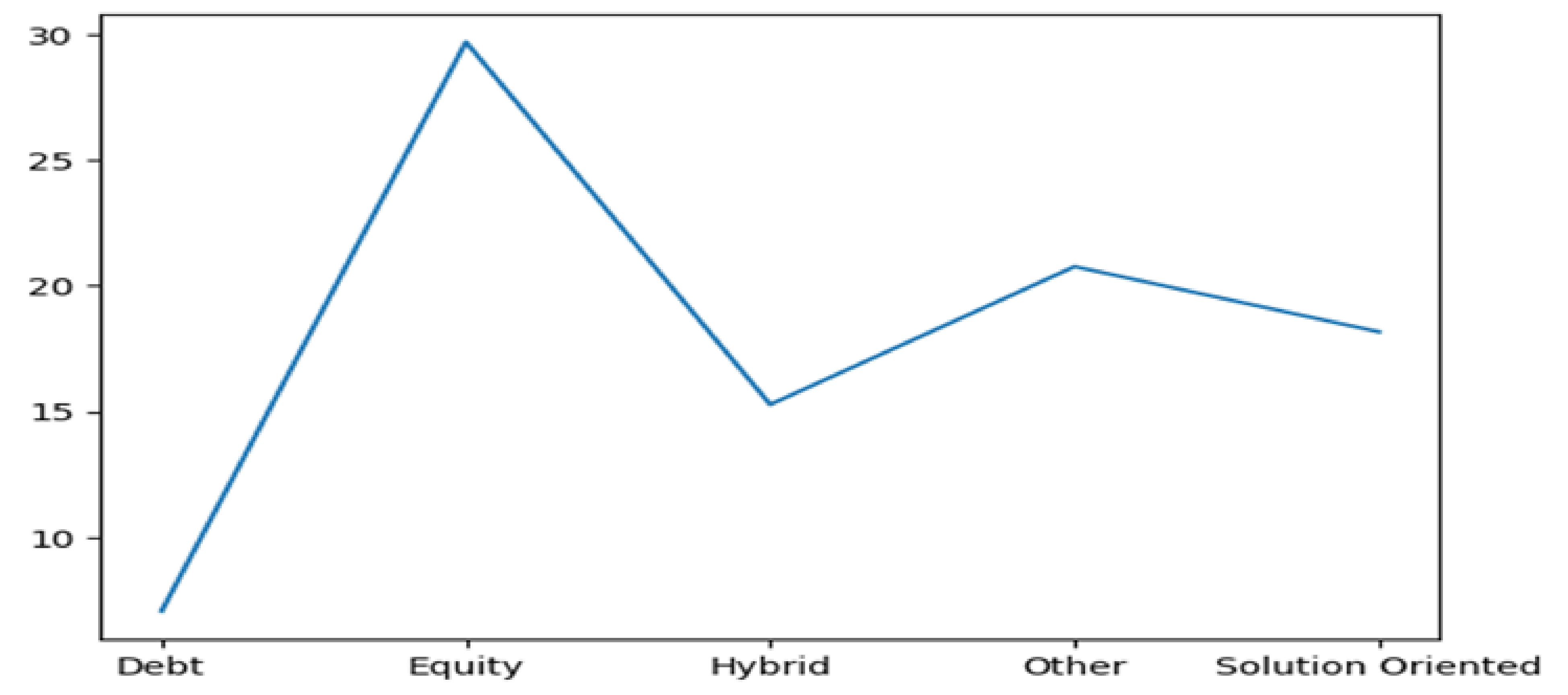
- **Bank of India Credit Risk Fund**
- **DSP World Gold Fund**
- **DSP World Mining Fund**
- **PGIM India GEO Fund**
- **Edelweiss Greater China Equity Off-Shore Fund**
- **Aditya Birla SL Banking&Financial Services-DirGrowth**
- **Motilal Oswal Nifty Bank Index Fund**
- **Nippon India Banking&Financial Services-DirGrowth**
- **UTI-Banking and Financial Services Fund**
- **HDFC Infrastructure Fund**

From the above mutual funds shows that the high risk. When Sharpe ratio & Sortino ratio is low which is less than 0.5 then risk return tread off show high risk and moderate-high return. i.e. High risk & low return. Which can be dangerous for investors. So we can suggest to mutual fund investors that avoid those all schemes for investment.

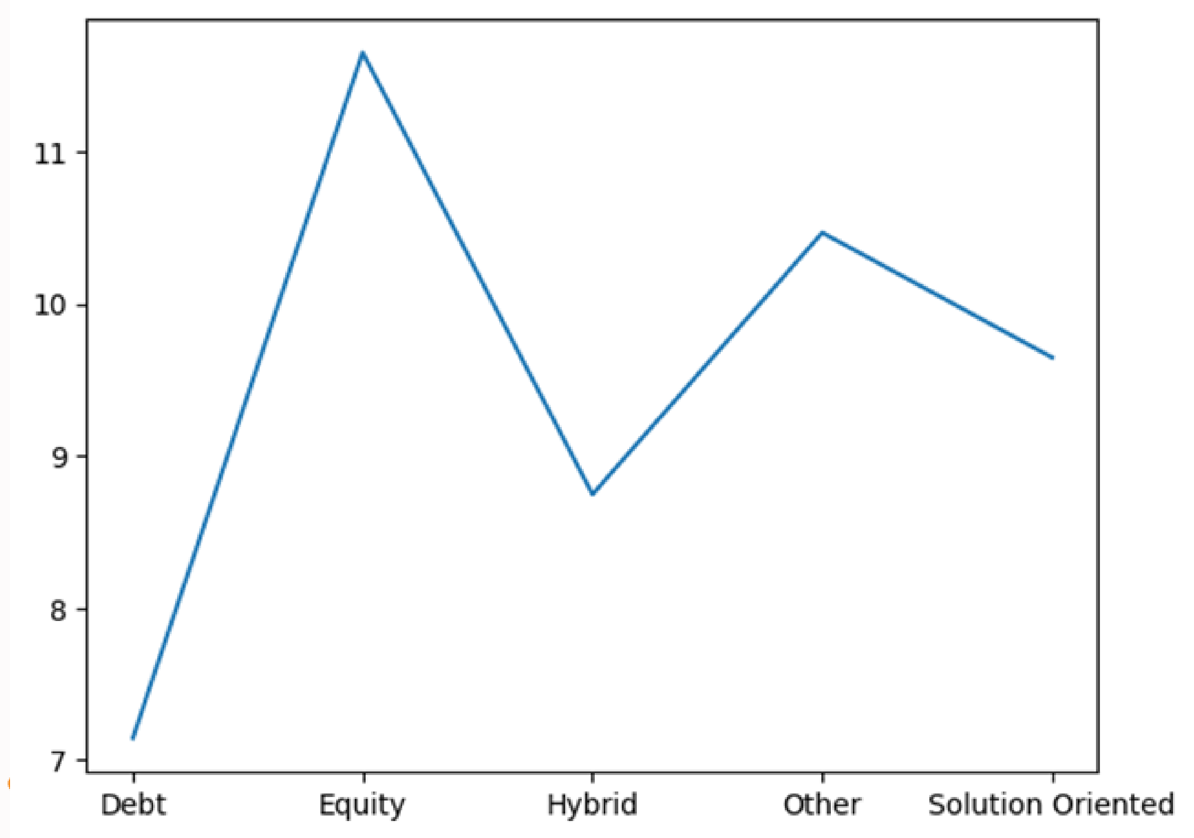
Mean Profile Plot of 1st, 3rd & 5th Year Returns Category



1st year returns category



3rd year returns category



5th year returns category

- **1st year returns:**

The highest return in the "returns_1yr" category is observed in the "Debt" category, with a return value of 5.5%.

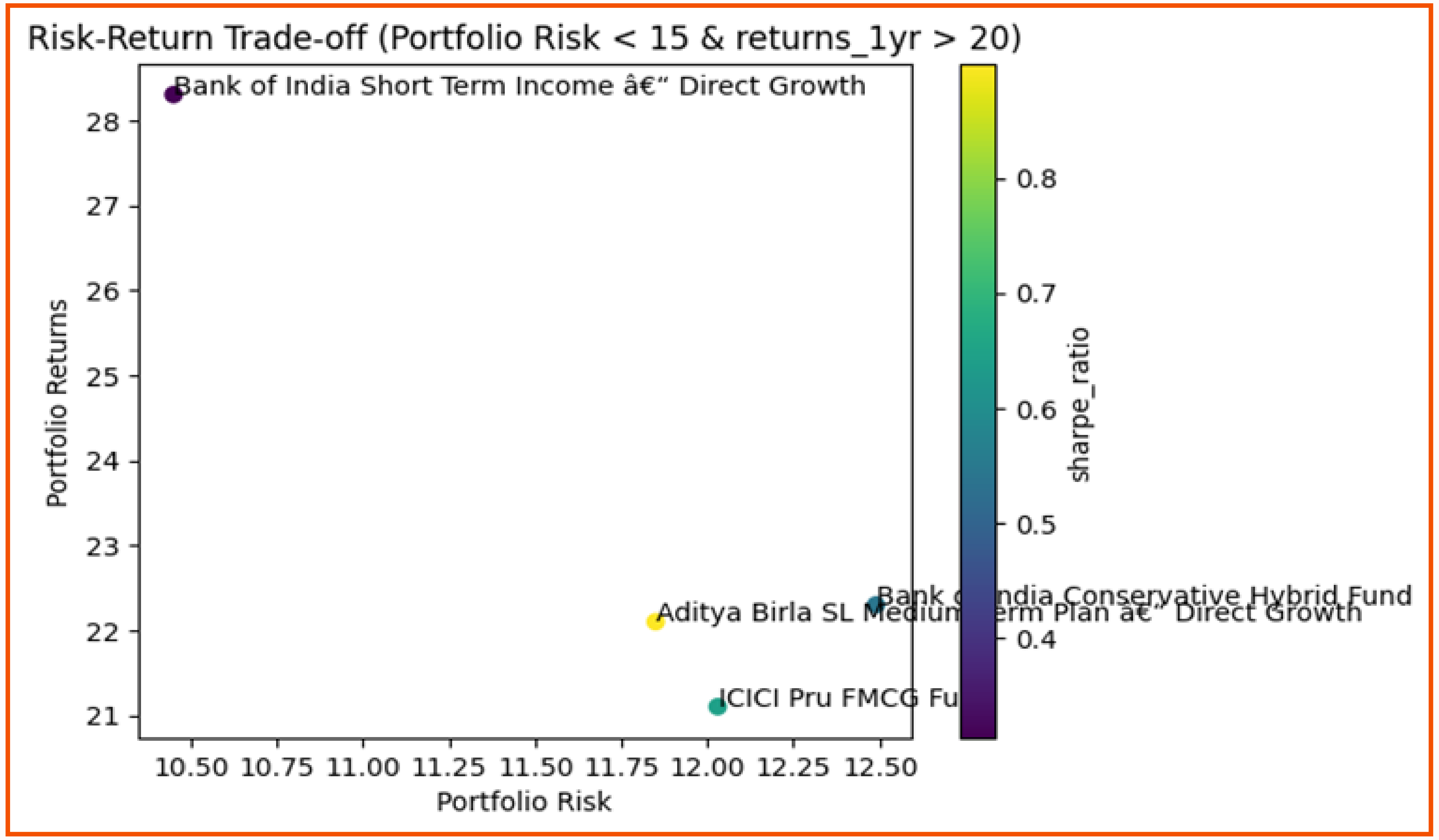
- **3rd year returns:**

"Equity" has the highest return among the listed categories, with a return of approximately 29.70%.

- **5th year returns:**

"Equity" has the highest return among the listed categories, with a return of approximately 11.65%.

The schemes of 1st year return low risk with high return as compare to sharpe_ratio

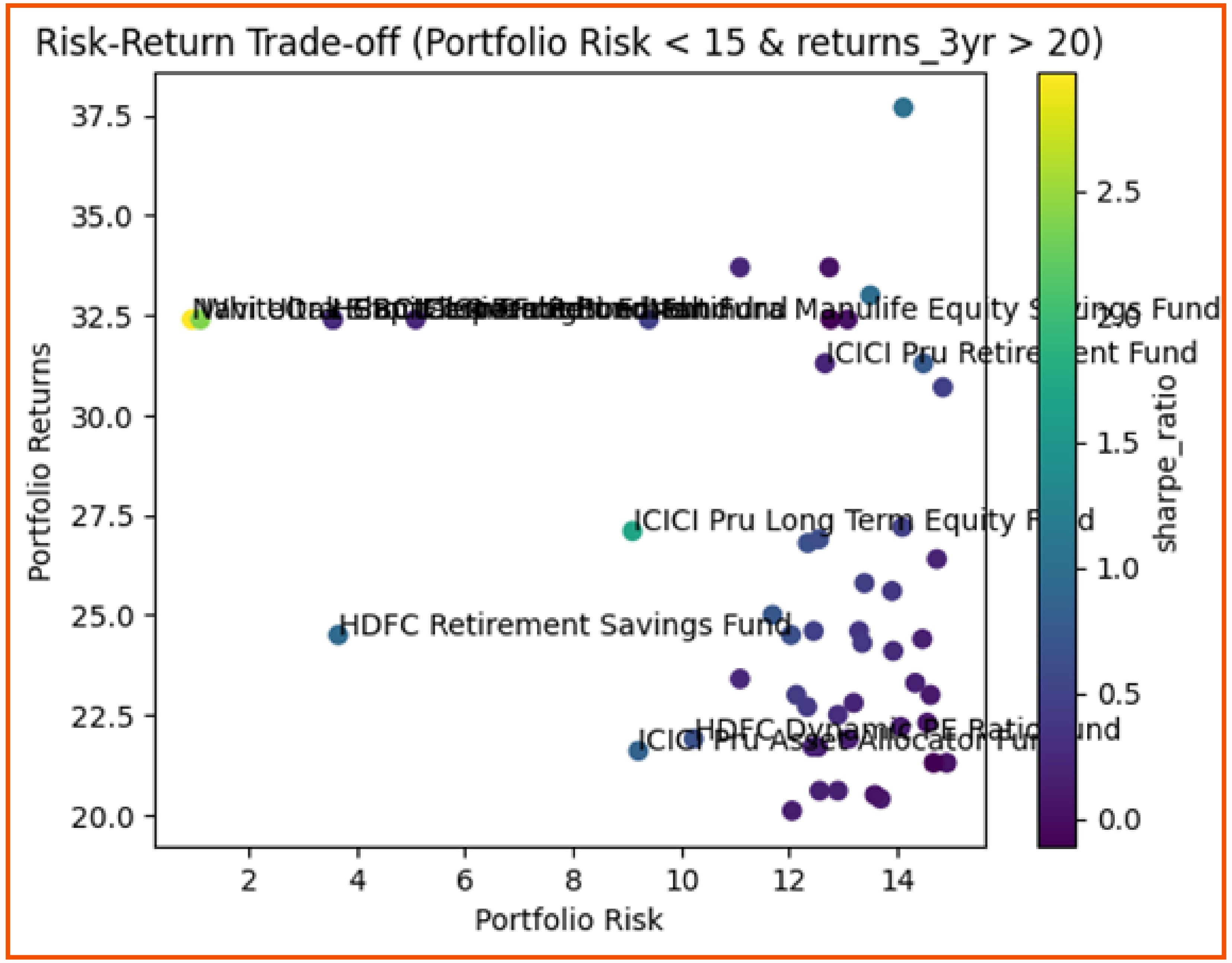


Schemes of 1st year return low risk with high return. We have extract top schemes:

1. Bank of India Short Term Income â€“Direct Growth
2. Aditya Birla SL Medium Term Plan â€“Direct Growth
3. ICICI Pru FMCG Fund
4. Bank of India Conservative Hybrid Fund

From the above mutual funds schemes shows that the low risk. i.e. low risk & moderate high returns. Which can be beneficial for investors. So, we can suggest to mutual fund investors that invest in those all mutual fund schemes for 1st year time period.

The schemes of 3rd year return low risk with high return as compare to sharpe_ratio

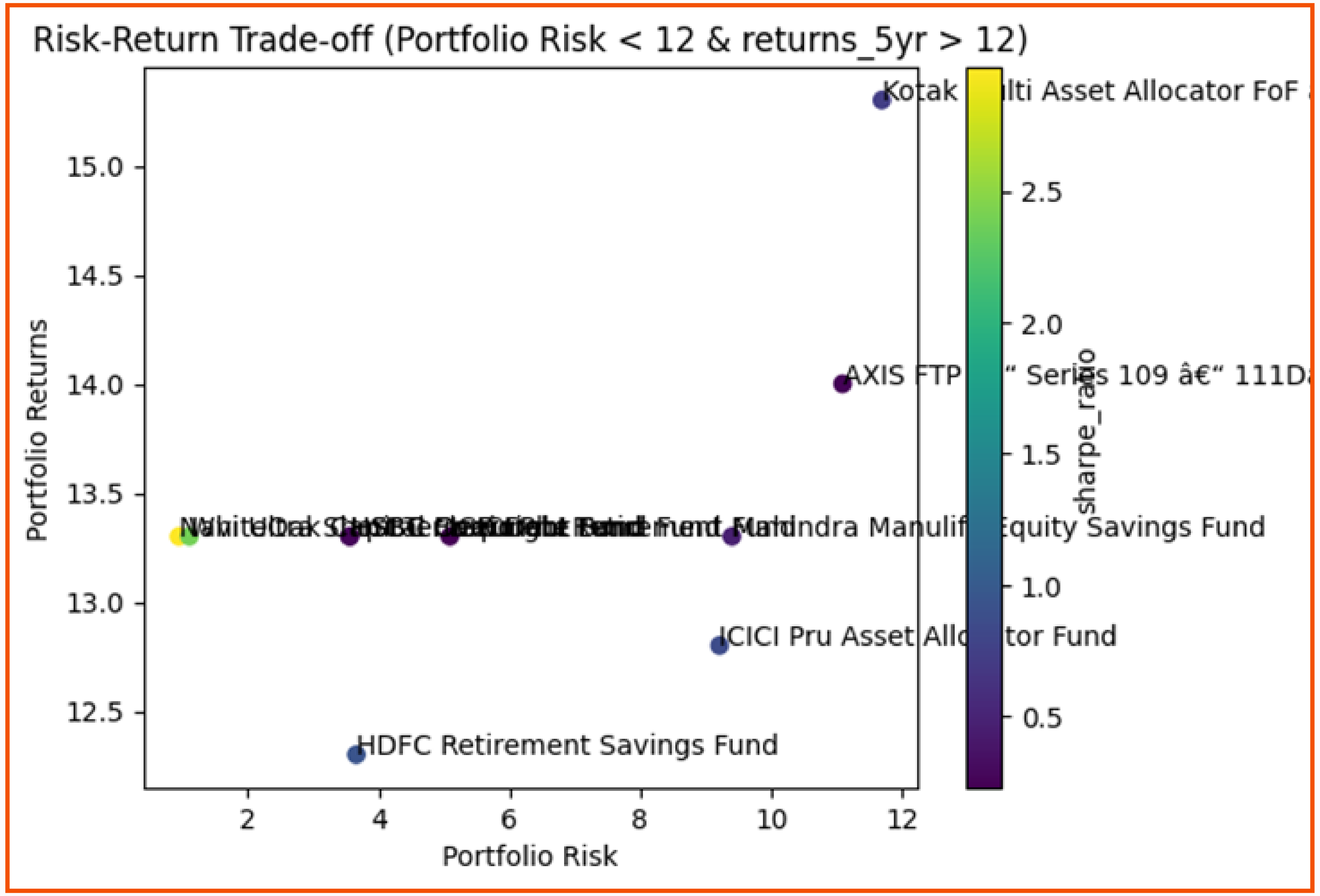


Schemes of 3rd year return low risk with high return. We have extract top 10 schemes

1. Navi Ultra Short Term Fund
2. WhiteOak Capital Overnight Fund
3. HSBC Corporate Bond Fund
4. HSBC Flexi Debt Fund
5. HDFC Retirement Savings Fund
6. ICICI Pru Retirement Fund
7. ICICI Pru Long Term Equity Fund
8. ICICI Pru Asset Allocator Fund
9. Mahindra Manulife Equity Savings Fund
10. HDFC Dynamic PE Ratio Fund

From the above mutual funds schemes shows that the low risk. i.e. low risk & moderate high returns. Which can be beneficial for investors. So, we can suggest to mutual fund investors that invest in those all mutual fund schemes for 3rd year time period.

The schemes of 5th year return low risk with high return as compare to sharpe_ratio



Schemes of 5th year return low risk with high return. We have extract top 10 schemes

1. Mahindra Manulife Equity Savings Fund
2. AXIS FTP â€“Series 109 â€“ 111Days
3. Kotak Multi Asset Allocator FoF â€“ Dynamic â€“ Direct Growth
4. HSBC Flexi Debt Fund
5. HDFC Retirement Savings Fund
6. ICICI Pru Retirement Fund
7. ICICI Pru Asset Allocator Fund
8. WhiteOak Capital Overnight Fund
9. Navi Ultra Short-Term Fund
10. HSBC Corporate Bond Fund

From the above mutual funds schemes shows that the low risk. i.e. low risk & moderate returns. Which can be beneficial for long term investment. So, we suggest to mutual fund investors that invest in those all mutual fund schemes for 5th year long time period.

Multivariate Technique : Cluster Analysis

Our aim is that to identify the best portfolio of securities also to help the investors to decide the effective portfolio of securities. This purpose we use the k-means clustering and identify best schemes in mutual fund. Mutual fund dataset there are 39 banks were selected for analysis such as (Aditya Birla Sun Life, Axis, Bandhan, Bank of India, Baroda BNP Paribas, Edelweiss, Canara Robeco, DSP, Franklin Templeton, HDFC, HSBC, ICICI Prudential, IDBI, IIFL, Indiabulls, Invesco, ITI, JM Financial, Kotak Mahindra, L&T, LIC, Mahindra Manulife, Mirae Asset, Motilal Oswal, Navi, Nippon India, PPFAS, PGIM India, Quant, Quantum, SBI, Shriram, Sundaram, Tata, Taurus, Trust, Union, UTI, Whiteoak Capital). Clustering model fit in each particular returns.

1st year returns:

1st year returns cluster model divides schemes into six cluster.

Final Cluster Centers

	Cluster					
	1	2	3	4	5	6
returns_1yr	-.85	3.94	5.45	4.11	23.45	11.29
Portfolio_risk	12.68	4.38	1.67	11.14	11.71	12.57
Sharpe_ratio	.03	.79	2.61	.32	.60	.44

Final cluster centers table shows that,

- **Cluster 1 having Low /Negative Return**
- **Cluster 2 having Low to Moderate Return**
- **Cluster 3 having Low to Moderately High Return**
- **Cluster 4 having Low to Moderate Return**
- **Cluster 5 having Very High Return**
- **Cluster 6 having High Return**

- **The 1st cluster consists of 36 schemes:** Aditya Birla SL Equity Hybrid â€™95 Fund, Aditya Birla SL Inter Equity â€“Plan A-Direct Growth, AXIS Equity Hybrid Fund and so on.

- **The 2nd cluster consists of 139 schemes:** Aditya Birla SL Banking & PSU Debt Fund, AXIS All Seasons Debt Fund, Baroda BNP Paribas Conservative Hybrid Fund and so on.

- The 3rd cluster consists of 182 schemes: Aditya Birla SL Arbitrage Fund, AXIS Arbitrage Fund, Bank of India Liquid Fund and so on.

- The 4th cluster consists of 77 schemes: Aditya Birla SL Asset Allocator FoF-Dir Growth, AXIS Equity Saver Fund, Baroda BNP Paribas Aggressive Hybrid Fund and so on.

- The 5th cluster consists of 4 schemes: Aditya Birla SL Medium Term Plan â€“ Direct Growth, Bank of India Conservative Hybrid Fund, Bank of India Short Term Income â€“ Direct Growth, ICICI Pru FMCG Fund.
- The 6th cluster consists of 21 schemes: Aditya Birla SL Gold Fund, HDFC Dynamic PE Ratio Fund, ICICI Pru Bharat Consumption Fund and so on.

So as per all over cluster considering we can say that 1st year returns clustering output that 5th cluster shows important mutual fund schemes because Return is 23.45 which is high compared to other cluster returns, and their corresponding portfolio risk is 11.71, Sharpe ratio is 0.60. Number of cases in 5th cluster is 4 we also retrieved mutual fund schemes names over here

- Aditya Birla SL Medium Term Plan â€“ Direct Growth
- Bank of India Conservative Hybrid Fund
- Bank of India Short Term Income â€“ Direct Growth
- ICICI Pru FMCG Fund

3rd year returns:

3rd year returns cluster model divides schemes into three cluster.

Final Cluster Centers

	Cluster		
	1	2	3
returns_3yr	15.70	5.77	26.72
Portfolio_risk	10.36	2.65	11.61
Sharpe_ratio	.27	1.93	.50

Final cluster centers table shows that,

- **Cluster 1 having Moderate Return**
- **Cluster 2 having Low Return**
- **Cluster 3 having High Return**

- **The 1st cluster consists of 118 schemes:** Aditya Birla SL Balanced Advantage Fund, AXIS Balanced Advantage Fund, AXIS FTP â€“ Series 109 â€“ 111Days and so on.

- **The 2nd cluster consists of 295 schemes:** Aditya Birla SL Active Debt Multi-Mgr FoF-Dir Growth, AXIS All Seasons Debt Fund, Baroda BNP Paribas Credit Risk Fund and so on.

- **The 3rd cluster consists of 46 schemes:** Franklin India Equity Hybrid Fund, HSBC Equity Hybrid Fund, ICICI Pru Exports and Services Fund and so on.

So as per all over cluster considering we can say that 3rd year returns clustering output that **3rd cluster shows important mutual fund schemes** because Return is 26.72 which is high compared to other cluster returns, and their corresponding portfolio risk is 11.61, Sharpe ratio is 0.50. Number of cases in 3rd cluster is 46 we retrieved only top 12 mutual fund schemes names over here

- Templeton India Equity Income Fund
- L&T Focused Equity Fund
- Tata Retirement Savings Fund
- Parag Parikh Tax Saver Fund
- HSBC Corporate Bond Fund
- HSBC Equity Hybrid Fund
- HSBC Flexi Debt Fund
- ICICI Pru Retirement Fund
- Mahindra Manulife Equity Savings Fund
- Motilal Oswal Equity Hybrid Fund
- Navi Ultra Short-Term Fund
- WhiteOak Capital Overnight Fund

5th year returns:

5th year returns cluster model divides schemes into four cluster.

Final Cluster Centers

	Cluster			
	1	2	3	4
returns_5yr	5.86	9.75	7.09	9.41
Portfolio_risk	2.02	1.74	4.82	10.24
Sharpe_ratio	2.61	1.95	.61	.36

Final cluster centers table shows that,

- **Cluster 1 having Low Return**
- **Cluster 2 having High Return**
- **Cluster 3 having Moderate Return**
- **Cluster 4 having Moderate High Return**

- **The 1st cluster consists of 150 schemes:** Aditya Birla SL Arbitrage Fund, AXIS Arbitrage Fund, Bank of India Liquid Fund and so on.

- **The 2nd cluster consists of 66 schemes:** HSBC Corporate Bond Fund, Navi Ultra Short-Term Fund, WhiteOak Capital Overnight Fund and so on.

- **The 3rd cluster consists of 109 schemes:** Aditya Birla SL Dynamic Bond Fund, AXIS Retirement Savings Fund, Baroda BNP Paribas Credit Risk Fund and so on.

- **The 4th cluster consists of 65 schemes:** Aditya Birla SL Active Debt Multi-Mgr FoF-Dir Growth, AXIS FTP â€“Series 109 â€“ 111Days, Baroda BNP Paribas Balanced Advantage Fund and so on.

So as per all over cluster considering we can say that 5th year returns clustering output that 2nd cluster shows important mutual fund schemes because Return is 9.75 which is high compared to other cluster returns, and their corresponding portfolio risk is 1.74 and Sharpe ratio is 1.95. Number of cases in 2nd cluster is 66 we retrieved only top 6 mutual fund schemes names over here

- HSBC Corporate Bond Fund
- HSBC Flexi Debt Fund
- ICICI Pru Retirement Fund
- Navi Ultra Short-Term Fund
- WhiteOak Capital Overnight Fund
- HDFC Retirement Savings Fund

CONCLUSION

In this study, we successfully achieved
Explore factors influencing the performance of mutual funds. Using EDA plot we check our data in graphical way,
we conclude that

- Equity category is showing the highest number of schemes (308) of total 814 Schemes.
- Asset Management Company (AMC) ICICI Prudential Mutual Fund has highest number of Schemes 57 out of 814.
- Equity category funds gives the highest returns in all years, 1st year, returns 3rd year, returns 5th year.

In each year returns we have identified schemes which gives low risk with high return. This purpose using Fundamental Principal: the risk-return trade-off for different mutual fund portfolios.

3rd and 5th year high returns mutual fund gives low risk with high return.

• Navi Ultra Short-Term Fund	• WhiteOak Capital Overnight Fund
• HSBC Corporate Bond Fund	• HDFC Retirement Savings Fund
• HSBC Flexi Debt Fund	• ICICI Pru Retirement Fund
• ICICI Pru Asset Allocator Fund	• Mahindra Manulife Savings Fund

To identify the best portfolio of securities. **This purpose we use the k-means clustering and identify best schemes in mutual fund.**

1st and 3rd year high return mutual fund gives the low risk with high returns.

- **ICICI Pru FMCG Fund**

3rd and 5th year return gives the low risk with high returns.

- **HDFC Retirement Savings Fund**
- **HSBC Corporate Bond Fund**
- **HSBC Flexi Debt Fund**

- **Navi Ultra Short Term Fund**
- **WhiteOak Capital Overnight Fund**
- **ICICI Pru Retirement Fund**

To help the investors to decide the effective portfolio of securities.

If investor wants invest money the period of 1st year & 3rd year then we suggest that ICICI Pru FMCG Fund because that it takes low risk with give the best 1st year returns 21.1% and 3rd year returns 24.5%. Also it is Sharpe ratio & Sortino ratio greater than 1. It management fees 1.44%. There fund size 1156 Cr. So here all factor show the satisfaction about best effective portfolio of securities. So, we suggest that ICICI Pru FMCG Fund is the best portfolio of securities.

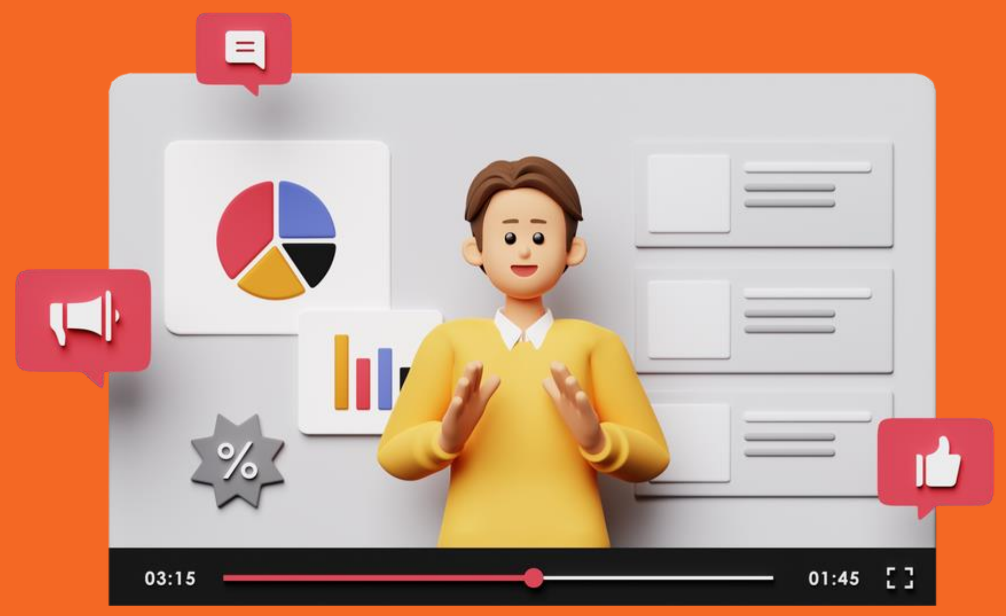
If investor wants invest money the period of 3rd year & 5th year then we suggest that

Scheme Name	3rd year Return	5th year Return	management fees	Fund size in Cr
• HDFC Retirement Savings Fund	34.9	14.8	0.78	2696
• HSBC Corporate Bond Fund	32.4	13.3	0.35	157
• HSBC Flexi Debt Fund	32.4	13.3	0.94	54
• ICICI Pru Retirement Fund	32.4	13.3	1.12	152
• Navi Ultra Short Term Fund	32.4	13.3	0.73	11
• WhiteOak Capital Overnight Fund	32.4	13.3	0.22	14

Because that those takes low risk with give the best 3rd year returns and moderate 5th year returns. Those management fees are also very minimum. So here all factor shows the satisfaction about best effective portfolio of securities. So, we suggest that those all above mutual fund schemes are the best portfolio of securities.

Reference

- **Disha Thakkar** (ICICI Mutual Fund, Anand Gujarat)
- **Aman Sir** (HDFC Mutual Fund, Pune Maharashtra)
- **Utkarsh Mishra** (Senior Manager, Bank of Baroda , Mumbai)



Book: Bhuyan, K.C. (2004). Multivariate analysis and its application. New Central Book Agency (P) LTD. (171-193)

Link : https://youtu.be/X1rbN1VRaxc?si=-arGWyegjWPMMcdl

Thank You!