

Financial Planner and Asset Allocation Using Machine Learning

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Abstract—While the rise in the Mutual Fund industry has been meteoric, the analytical tools necessary to make intelligent investment decisions have been a laggard. It is generally the small cap stocks which provide the alpha (additional return generated beyond the returns generated by investing in stock indices such as the Nifty or the Sensex). As the small cap sector is generally ignored by the analyst community, they tend to be the most inefficiently priced stocks. Also, since large institutional investors don't invest in these companies, they tend to be relatively illiquid. By developing right kind of statistical tools, alpha can be generated by intelligently switching from large cap to small cap fund after serious episodes of volatility or market turmoil had taken place. The statistical tools will aid in gauging the level of market turmoil and will provide us appropriate switching signals. The starting point of this kind of alpha generation is a balanced portfolio between all the asset classes with extremely low correlated asset stream returns. This balanced portfolio is optimized by using the modern portfolio theory.

Keywords—Mutual Funds, Stocks, AMFI, Asset Management, Portfolio Management

Introduction

Using the modern portfolio theory, we will construct an all weather portfolios. This portfolio will not generate exceptional returns but would remain sturdy as it would invest significant portions of funds in safe haven asset classes such as the the government bonds, gold funds etc. While this portfolio will underperform during the bull markets due to low exposure to risky assets, it will be less susceptible to adverse changes in the global markets. Our portfolio will only switch into riskier asset classes once we get the switching signal from our statistical tools. components, incorporating the applicable criteria that follow.[2]

Preliminaries

In today's well advertised financial industry, people allocate and choose funds merely based on past returns, without accounting for volatility, drawdowns and personal risk appetite .Most customers invest arbitrary amount of money through well advertised SIP route, leaving the following factors unaccounted for:

1. Is the monthly installment enough to achieve the desired goal?

2. Rebalancing of portfolio with passage of time and change in risk appetite
3. Optimal mode of transaction (While SIP might be a good way to invest in equities, it is an sub optimal way to invest in debt-fund or balanced funds)

While the goals of most investors are quite diverse, people's awareness about the different types and characteristics of Mutual Funds, Equities is poor relative to other asset classes. In order to address the above shortfalls of sub-optimal asset allocation, we have tried to build a web based machine learning platform which would help the user to construct well diversified risk adjusted portfolios.

With Reserve Bank of India adopting an inflation targeting regime, it is clear that India will have positive real interest rate regime over the foreseeable future. This is a structural shift in Indian economic system and will promote financialization of savings in capital market products such as Mutual Funds and Insurance derivatives which would benefit from positive real rate environment and growth in Indian economy. Traditionally, Indians have saved in the form of investments in gold or real estate. These proved to be beneficial in a high inflationary environment but would fall out of favor as these asset classes do not generate any cash flows and merely serve as inflation hedges. With this dramatic undercurrent in the play, it is imperative that the retail investors are guided to make appropriate asset allocation decision as 97% of variance in returns of portfolio is linked to this single factor

Markowitz Portfolio Theory to determine Asset Allocation

Based on Markowitz's modern portfolio theory, an efficient frontier of funds at various risk and return levels will be constructed.[5]

Based on the efficient frontier and required rate of return, portfolio weights will be computed through an optimization function. (which will try to achieve required rate of return while minimizing the risk through appropriate diversification and inclusion of low correlated portfolios)

Definition 1: The efficient frontier selects the best optimal portfolios for a given risk with highest expected return compared to other alternate portfolios.

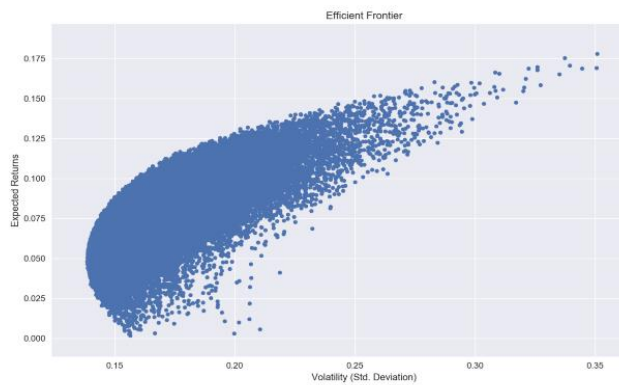


Fig 1: Efficient Frontier

Abbreviations and Acronyms

AMFI	Association of Mutual Funds in India
SIP	Systematic Investment Plan
NAV	Net Asset Value
CAGR	Compounded Annual Growth Rate
AUM	Asset Under Management
AMC	Asset Management Company
NISM	National Institute of Securities Markets
ANN	Artificial Neural Networks
PV	Present Value
FV	Future Value

Risk Aversion

Risk aversion is an investor's one of the highly desirable goal. Investors try to maximize the returns while keeping the risk as minimum as possible. When an investor encounters a situation with two investment options with similar risks a good investor will always optimize the portfolio with minimum risk. The goal should always be a good trade off between risk and return

Diversification and Portfolio Risks

The age-old wisdom about not putting all eggs in one basket applies very much in the case of portfolios. Consider a portfolio of 10 stocks with stocks from various sectors, this portfolio will ought to have a less risk exposure compared to a portfolio which is not diversified over multiple sectors. The market usually tends to treat the stocks of the same sectors in a similar fashion. When one IT sector stock suffers, chances are high that other stocks of IT sector may also perform badly. If however, we compare one IT services company with another from the metals space, say steel, which has high foreign debt, then a drop in the share price of the steel company (as the falling rupee would increase the debt-service payments of the steel firm). Such diversification provides the stability to the portfolio

Uniqueness in the solution

None of the existing investment platforms provide users with the ability to select investment instruments based on risk adjusted metrics. All of the investment platforms merely show the past returns of the past funds. Investing this way is quite hazardous as research shows that only 9% of top performing funds retain or better their ranking in the following year. It is possible to generate high returns by undertaking substantial amounts of risk when market forces serve as tailwinds. However, such an approach can seriously jeopardize users long term wealth creation prospects as this high risk approach would be susceptible to large draw-downs. Our platform addresses this problem by introducing a variety of quantitative metrics to evaluate the skills of manager under different market conditions. We would use following metrics: Sharpe ratio, Treynors ratio, Jensens alpha, Sortino Ratio, Upside market capture to downside market capture, and Custom ranking based on distribution of ranks in each of the above category.

The bedrock foundation of our platform stems from Markowitz's Modern Portfolio Theory, which received Nobel Prize as it greatly enhanced the prospect of systemic allocation of investment Funds. Sigifredo Laengle, Gino Loyola, Jose M. Merigo Mean Variance Portfolio selection with the ordered weighted average IEEE volume 25 Issue 2. Since, this theory was developed in an era when computing power was not spectacular, it was deterministic in nature. We have tried to use this theory and use it with modern Machine learning techniques in order to further optimize the outcomes of modern portfolio theory using Regression algorithms and classification techniques. We have drawn inspiration from John M. Mulveys, Machine learning and Financial Planning IEEE Potentials Volume 36, Issue 6 to implement these ML algorithms in the financial context. Also, in order to adhere to the domestic regulatory guidelines as mandated by the AMFI, we will try to build a platform which complies with the stipulated regulations. In order to embellish the app with cutting edge technologies, we have refereed to highest industry standards and adopted design patterns and frameworks as recommended in JavaScript in 2018.

Project Research

After Studying various research papers it occurs that the problems associated with portfolio selection are determining return on portfolios, Diversification applicability, diversifiable and non diversifiable risks. The goal for a optimal portfolio management should be a proper risk-return trade off. The risks broadly fall as systematic risk and non systematic risks which are common to most assets and specific to individual assets respectively. Systematic risks can be eliminated to a good level of extent by portfolio optimization. Investors should invest in diversified funds in order to reduce risk. [3][4][5]

Outcome

All the above publications are useful in isolation but draw a huge synergy when built to complement each other. We have tried to connect the various hooks and spokes in order to build a better platform to assist users in making smart investment decisions and achieve their financial goals.

Data Curation

This is the primary step in constructing the platform to optimize the asset allocation of the user. In this subsection of the system design we would automate the process of data gathering by developing a Nodejs API to download the historical as well as prospective data from AMFI's website. After raw data has been gathered, we would undertake the following steps to make data ready for our asset allocation algorithms to consume.

Step I

- Mutual Fund NAV data from AMFI
- User risk tolerance data through intelligent questions

Step II

- Normalize the data through appropriate statistical transformations in order to remove the outliers which could distort the analysis and interpretation of results
- Calculate descriptive statistical ratios such as CAGR returns, Sharpe Ratio, Value At Risk, downside deviation etc to filter the fund selection process.

Step III

- Feed the data in appropriate data structures in the database system (MongoDB)
- Create Indexes in the database system to optimize data retrieval process.

Result

Using the modern technology webstack, we have built a system that allows the user to allocate his assets in an optimal way keeping in mind the users return expectations and risk bearing profile. The user can also run regression for machine learning algorithm for various stocks listed on NIFTY



Fig 2: Dynamic Chart of a single mutual fund returns



Fig 3: BoxPlot of Mutual fund Returns for various time phases.

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