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Asset Management and Tax Calculation

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Abstract: ***Wealth management is a crucial part of life planning for which investing and management of assets plays a significant role. As much as wise investment in the finance market prevails in society, it is not the most sought after by the community because of the said as well as unsaid risks and majorly, absence of knowledge. In this project, with explanatory UI and user centric approach which has user requirement at its centre, the user is believed to navigate, understand and hence invest irrespective of possession of his domain knowledge***

Asset management and wealth shelter is a powerful web tool which can be used for purposes associated with wise investment, study of risks, and administer prevailing holdings in the finance sector. With the interactive and user-friendly UI, people with minimal knowledge or no knowledge can make use of the tool for equally effective results. There are some standalone applications which exist for each of the above mentioned intents but lack some of the vital features including understandable UI, use of live market data for accurate results, scope of flexibility according to user's need. These features have been mandatorily integrated in this project for best experience.

I. INTRODUCTION

The portfolio optimization is the process of selection of asset classes(or stocks) that are optimum for an investor. This allocation depends on the risk appetite of the investor and his/her return needs.

The financial market was considered a mere manifestation of luck and trades were considered as bets. It wasn't until 1952 when Harry Markowitz released his article "Portfolio Selection". He used mathematical formulae to calculate the relationship between the asset classes and thus was trustworthy. His technique uses historical data to give final outputs. The data provided can be daily/ weekly/ monthly/ annually depending on the investor's horizon. The model uses statistical concepts of correlation, standard deviation, mean return and many more which will be discussed in the following sections. So forth, Indian investors can select their own optimal portfolio that maximizes portfolio rate of return.

Our project is meant to be used by the common investors of india. It will help them make sound decisions regarding their financial goals and will enable them to plan accordingly. Our web application can be used by CFAs all around the globe to benchmark their analyses.

II. LITERATURE SURVEY

A. Markowitz's Portfolio Theory

Harry Markowitz once met a stock broker and he was advised to study the stock market. Being an economics graduate student, he developed the modern portfolio theory which went on to become the foundations of financial economics. His model recognised the risk return tradeoff, which is the foundation of economics. His work also earned him a nobel prize. His model decision considers not only the stock which should be picked but also weight proportions of each asset class. Since we are trying to make various combinations of risk and return, we can plot the permutations and combinations. This plot is called the efficient frontier and will be discussed in the following sections. The plot is of risk vs return. Risk forms the x axis and returns on the y axis. Risk forms the independent variable because it is the risk that determines the return. We will also discuss how risk exposure is necessary to attain excess gain[1]. Despite minor alterations in the original theory, the MPT is universally still applied. The other concept running in the MPT is asset allocation. Asset allocation is the process of selection of a portfolio of investments where each component forms an asset class. Asset allocation forms a separate section in our report.

B. Assumptions

Markowitz, while developing his theory, made the following assumptions upon which our report is also made.

1) Investors want to maximize the portfolio's expected return.
2) All markets are efficient (e.g. no taxes, no transaction costs).
3) All investors are risk-averse, that is they are willing to take a greater risk if they are given a greater return.
4) Investors have the same single period investment vision (Generally 3 years).

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C. Efficient Frontier

The efficient frontier gives out the optimal level of risk and return pair. Basically, an efficient frontier is a plot representing the risk and return as discussed in the aforementioned sections. Risk and expected returns are linked together[2]. There is also some tenderness between risk and return. As per Hagstrom, it is nearly impossible to produce returns without the exposure to some form of risk as discussed before. In order to generate money, some form of value needs to be added. Risk is the value when it comes to the stock market.

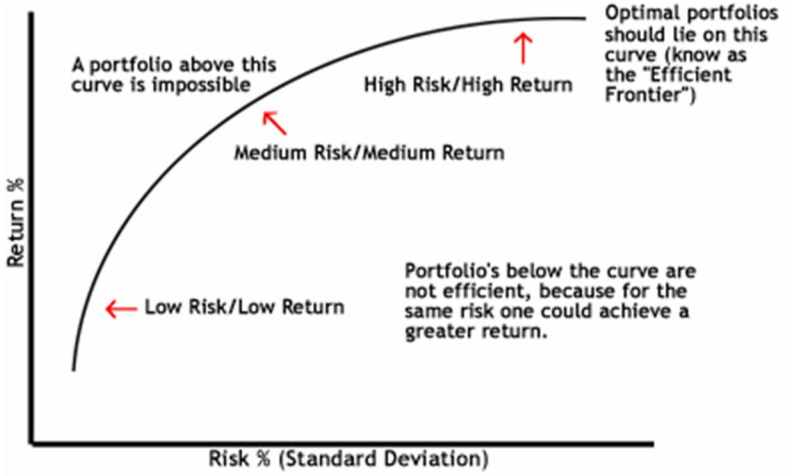

Figure 2.1 Risk vs Return Anatomy

As illustrated in the plot above there exists no portfolio over the frontier. Each point demarcates a distinct weighted portfolio. Considering one asset won't give us a portfolio with equally distributed weights of every asset.

D. Optimal Portfolio Theory

The optimization applies in the case when our investor is aware of the relationship between standard deviation and mean average (The correlation matrix). It can be seen from the following graph that the indifference curves (Derived from the risk appetite of the investor) show the standard deviation and average combinations[3].

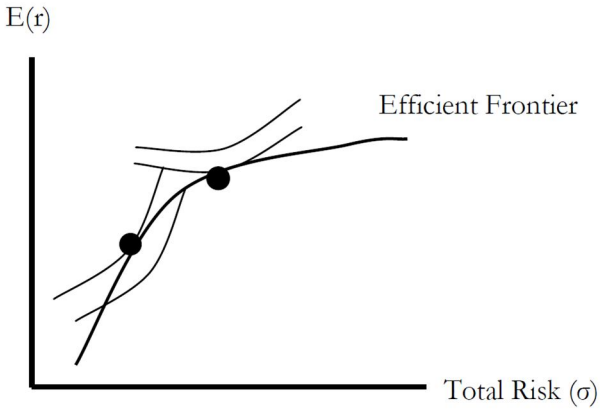

Figure 2.2 Efficient Frontier

Most of the investors tend to pick a portfolio that is somewhat an optimal portfolio.The chosen portfolio is the function of investor's decisions.

E. Asset Allocation

Asset allocation is the process that is carried out after the calculation of the final weights. The optimal portfolio is allocated to the respective investor based on his/her risk appetite[4]. The allocation process also has transaction charges due to the high frequency of trades. The number of assets allocated also depends on the number of assets the investor has chosen to sign up for.

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F. Passive and Active Management Styles of Investing

There are 2 types of investing styles prevalent in the market of any nation or community.

In the passive style of investing, the investor bets on the national market index(for ex- S&P 500, Dow jones (USA) and nifty 50, sensex in India). This way the investor is moving with the market neither above nor below. Since it is impossible for retail investors to have every stock in their portfolio based on market capitalization, there are several bank owned mutual funds to carry out the same. In passive investment style, the transaction costs are very less due to lesser volume of trades[5].

In the active style of investing, the investor indulges in frequent trading. It can be implemented through day trading, swing trading etc. Focus is more on the technical health of the asset and not many fundamentals are taken into consideration. The transaction costs are of course high due to g=higher volumes of trade. If the investor is informed enough, he/she can beat the market[6].

G. Tax Loss Harvesting

Whenever an individual invests in equity funds, he/she makes capital gains. These capital gains are taxable based on how long the investment is made for. Tax-loss harvesting reduces tax liability on investments. It is a method to reduce the capital gains made on equity against the capital loss suffered to pay a lesser amount of tax.

In the past, the LTCG made on liquidating equity shares were completely tax-free. However, the amendment made in the Union Budget 2018 has changed the tax consideration of LTCG on sale of listed equity shares[7].

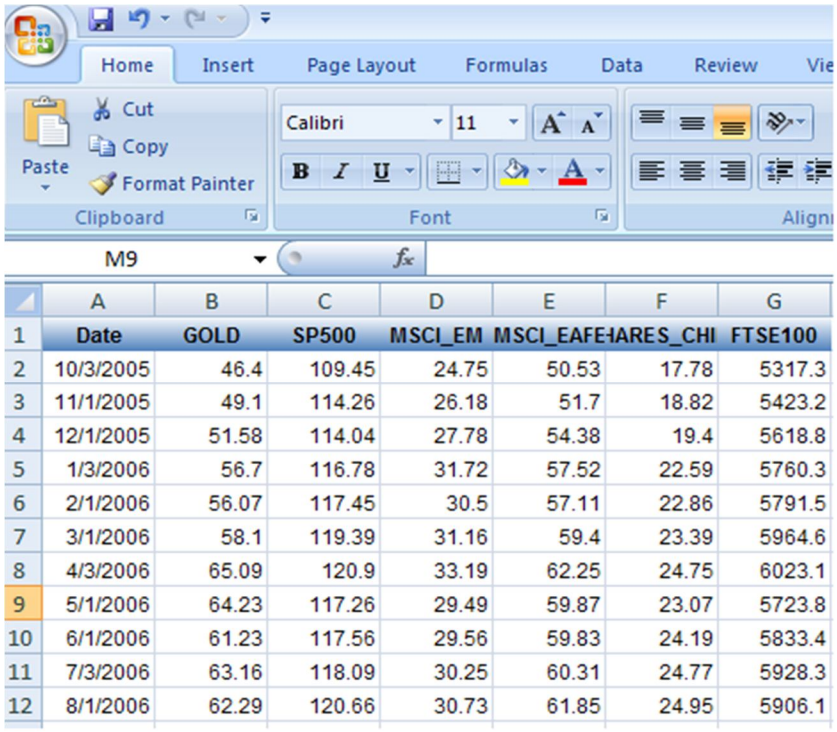
From 1 April 2018, an LTCG of more than Rs 1 lakh will be taxed at 10%. While short-term capital gains (STCG) are taxed at 15%. The investor can employ tax-loss harvesting to reduce the tax liability on both LTCG and STCG. Investors can use it for STCG because the tax rates on short-term capital gains are higher than that of long-term capital gains[8].

H. Technical Approach

Our study started off by finding contemporary practices relevant in the investment industry. MS Excel is a prevalent tool that is being used to implement the MPT. As discussed earlier, most of the steps are redundant and can be reduced to a single button if coded properly. Since our project is a form of service to the users, we decided to implement our project either in the form of an android application or a website. Our team has a grip over web development, we decided to make a website.

This is how portfolios are optimised using MS Excel[9]-

1) Create a spreadsheet which includes asset prices for the chosen frequency. In our case asset prices the interval is monthly.



	A	B	C	D	E	F	G
1	Date	GOLD	SP500	MSCI_EM	MSCI_EAFE	ARES_CHI	FTSE100
2	10/3/2005	46.4	109.45	24.75	50.53	17.78	5317.3
3	11/1/2005	49.1	114.26	26.18	51.7	18.82	5423.2
4	12/1/2005	51.58	114.04	27.78	54.38	19.4	5618.8
5	1/3/2006	56.7	116.78	31.72	57.52	22.59	5760.3
6	2/1/2006	56.07	117.45	30.5	57.11	22.86	5791.5
7	3/1/2006	58.1	119.39	31.16	59.4	23.39	5964.6
8	4/3/2006	65.09	120.9	33.19	62.25	24.75	6023.1
9	5/1/2006	64.23	117.26	29.49	59.87	23.07	5723.8
10	6/1/2006	61.23	117.56	29.56	59.83	24.19	5833.4
11	7/3/2006	63.16	118.09	30.25	60.31	24.77	5928.3
12	8/1/2006	62.29	120.66	30.73	61.85	24.95	5906.1

Figure 2.3 Historical Stock Data in Excel

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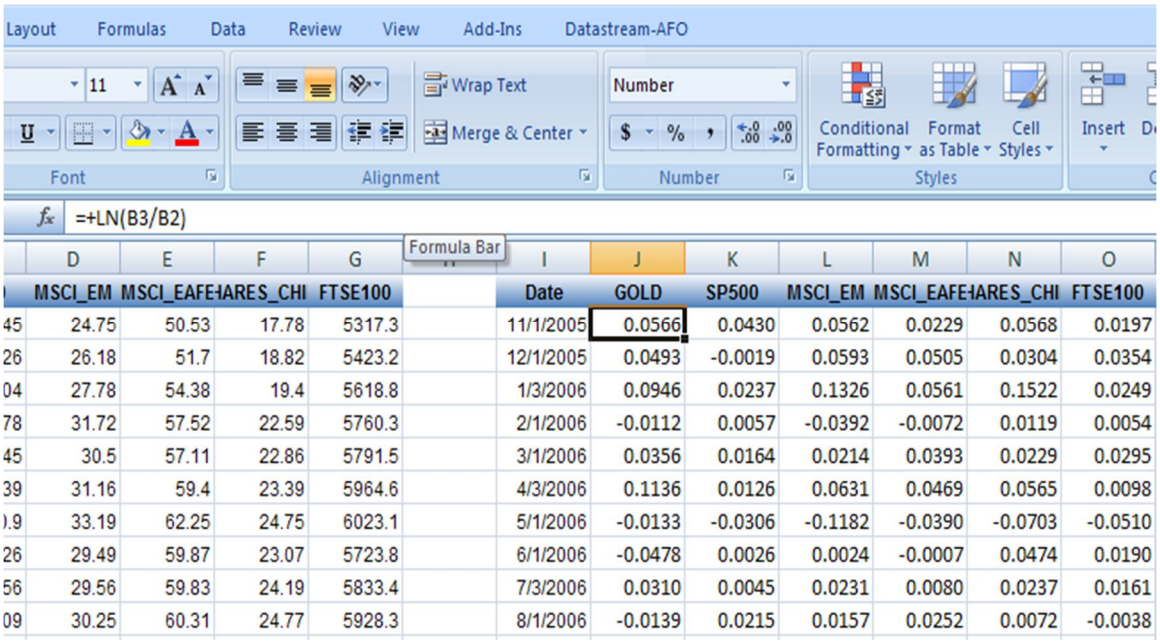
2) Calculate returns from the prices (the formula can be seen in the formula bar).

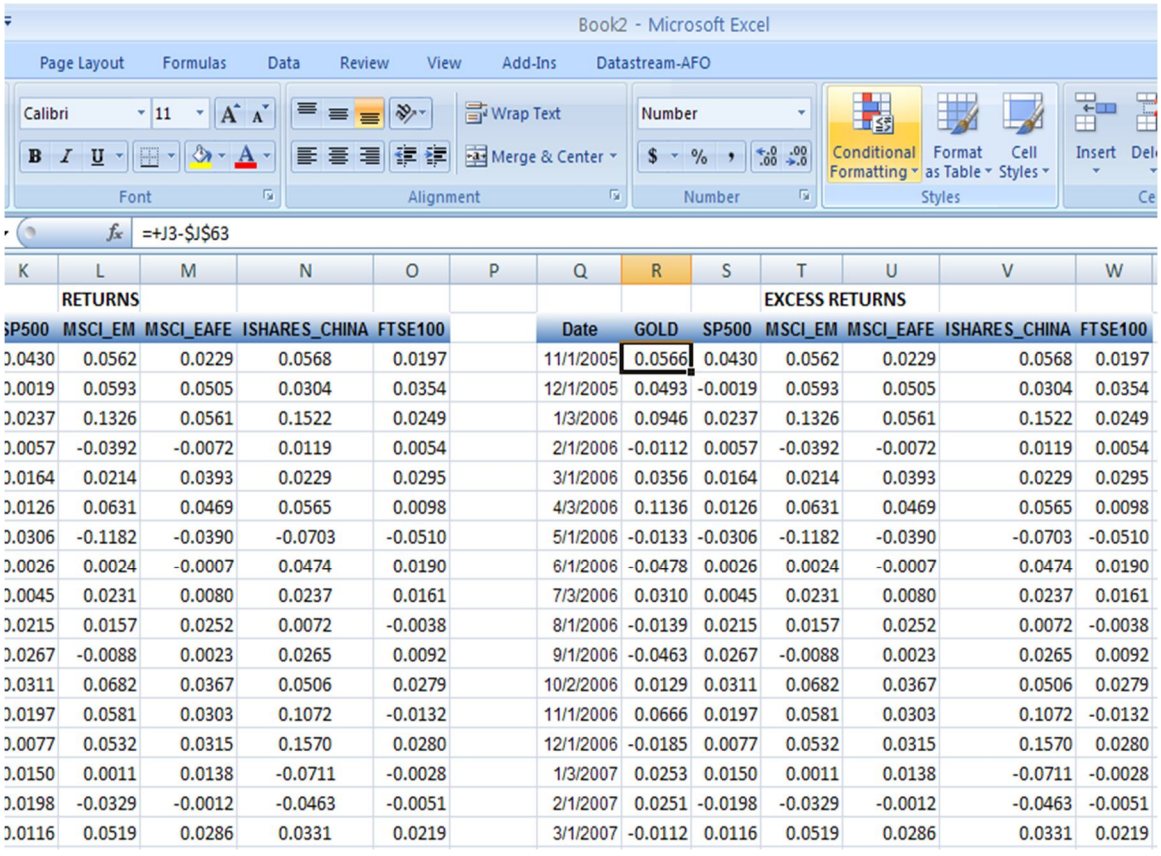


	D	E	F	G		I	J	K	L	M	N	O
	MSCI_EM	MSCI_EAFE	ARES_CHI	FTSE100		Date	GOLD	SP500	MSCI_EM	MSCI_EAFE	ARES_CHI	FTSE100
45	24.75	50.53	17.78	5317.3		11/1/2005	0.0566	0.0430	0.0562	0.0229	0.0568	0.0197
26	26.18	51.7	18.82	5423.2		12/1/2005	0.0493	-0.0019	0.0593	0.0505	0.0304	0.0354
04	27.78	54.38	19.4	5618.8		1/3/2006	0.0946	0.0237	0.1326	0.0561	0.1522	0.0249
78	31.72	57.52	22.59	5760.3		2/1/2006	-0.0112	0.0057	-0.0392	-0.0072	0.0119	0.0054
45	30.5	57.11	22.86	5791.5		3/1/2006	0.0356	0.0164	0.0214	0.0393	0.0229	0.0295
39	31.16	59.4	23.39	5964.6		4/3/2006	0.1136	0.0126	0.0631	0.0469	0.0565	0.0098
.9	33.19	62.25	24.75	6023.1		5/1/2006	-0.0133	-0.0306	-0.1182	-0.0390	-0.0703	-0.0510
26	29.49	59.87	23.07	5723.8		6/1/2006	-0.0478	0.0026	0.0024	-0.0007	0.0474	0.0190
56	29.56	59.83	24.19	5833.4		7/3/2006	0.0310	0.0045	0.0231	0.0080	0.0237	0.0161
09	30.25	60.31	24.77	5928.3		8/1/2006	-0.0139	0.0215	0.0157	0.0252	0.0072	-0.0038

Figure 2.4 Returns in MS Excel

3) Calculate the average return for each asset using the AVERAGE function.

4) Create the variance-covariance matrix. For that, we make the excess return matrix as shown below.



	K	L	M	N	O	P	Q	R	S	T	U	V	W
		RETURNS								EXCESS RETURNS			
	SP500	MSCI_EM	MSCI_EAFE	ISHARES_CHINA	FTSE100		Date	GOLD	SP500	MSCI_EM	MSCI_EAFE	ISHARES_CHINA	FTSE100
	0.0430	0.0562	0.0229	0.0568	0.0197		11/1/2005	0.0566	0.0430	0.0562	0.0229	0.0568	0.0197
	0.0019	0.0593	0.0505	0.0304	0.0354		12/1/2005	0.0493	-0.0019	0.0593	0.0505	0.0304	0.0354
	0.0237	0.1326	0.0561	0.1522	0.0249		1/3/2006	0.0946	0.0237	0.1326	0.0561	0.1522	0.0249
	0.0057	-0.0392	-0.0072	0.0119	0.0054		2/1/2006	-0.0112	0.0057	-0.0392	-0.0072	0.0119	0.0054
	0.0164	0.0214	0.0393	0.0229	0.0295		3/1/2006	0.0356	0.0164	0.0214	0.0393	0.0229	0.0295
	0.0126	0.0631	0.0469	0.0565	0.0098		4/3/2006	0.1136	0.0126	0.0631	0.0469	0.0565	0.0098
	0.0306	-0.1182	-0.0390	-0.0703	-0.0510		5/1/2006	-0.0133	-0.0306	-0.1182	-0.0390	-0.0703	-0.0510
	0.0026	0.0024	-0.0007	0.0474	0.0190		6/1/2006	-0.0478	0.0026	0.0024	-0.0007	0.0474	0.0190
	0.0045	0.0231	0.0080	0.0237	0.0161		7/3/2006	0.0310	0.0045	0.0231	0.0080	0.0237	0.0161
	0.0215	0.0157	0.0252	0.0072	-0.0038		8/1/2006	-0.0139	0.0215	0.0157	0.0252	0.0072	-0.0038
	0.0267	-0.0088	0.0023	0.0265	0.0092		9/1/2006	-0.0463	0.0267	-0.0088	0.0023	0.0265	0.0092
	0.0311	0.0682	0.0367	0.0506	0.0279		10/2/2006	0.0129	0.0311	0.0682	0.0367	0.0506	0.0279
	0.0197	0.0581	0.0303	0.1072	-0.0132		11/1/2006	0.0666	0.0197	0.0581	0.0303	0.1072	-0.0132
	0.0077	0.0532	0.0315	0.1570	0.0280		12/1/2006	-0.0185	0.0077	0.0532	0.0315	0.1570	0.0280
	0.0150	0.0011	0.0138	-0.0711	-0.0028		1/3/2007	0.0253	0.0150	0.0011	0.0138	-0.0711	-0.0028
	0.0198	-0.0329	-0.0012	-0.0463	-0.0051		2/1/2007	0.0251	-0.0198	-0.0329	-0.0012	-0.0463	-0.0051
	0.0116	0.0519	0.0286	0.0331	0.0219		3/1/2007	-0.0112	0.0116	0.0519	0.0286	0.0331	0.0219

Figure 2.5 Excess Return table in MS Excel

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5) Calculate both portfolio return and portfolio variance using the variance covariance matrix.

Figure 2.6 Variance Covariance matrix in MS Excel

6) Use SOLVER to optimize the weights.

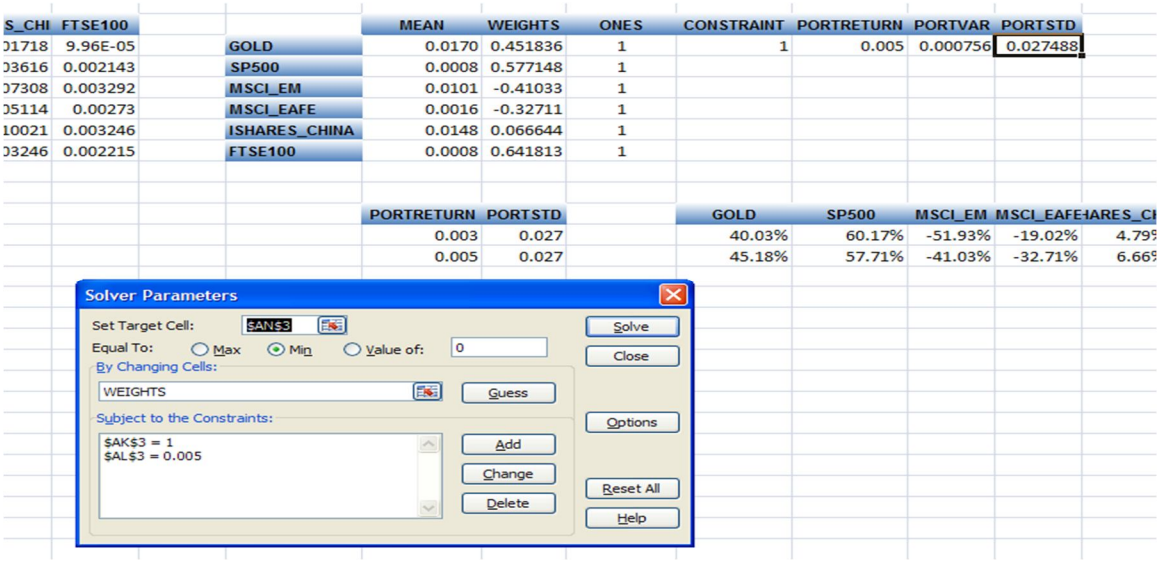

Figure 2.7 Solver in Excel

We can plot the efficient frontier by minimizing portfolio standard deviation.

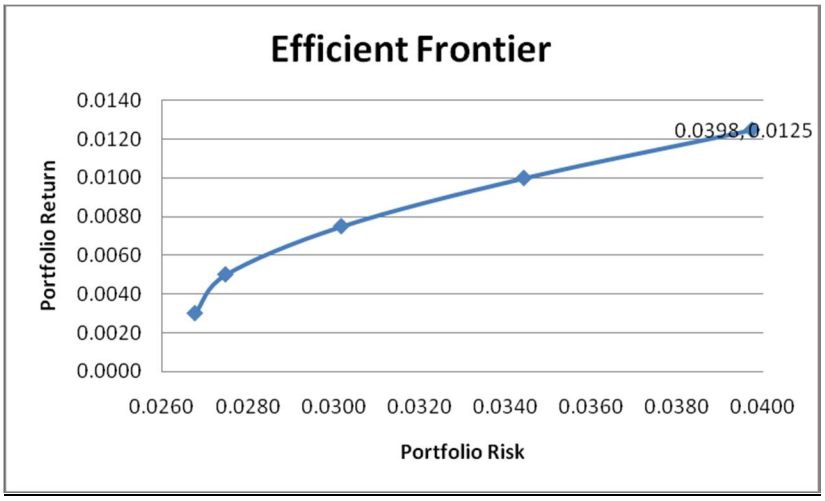

Figure 2.8 Efficient frontier in MS Excel

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III. PROPOSED WORK

A. *Technical Specification*

The software requirements we need over the life cycle of our project are as follows-

1) HTML
2) PHP
3) CSS
4) JavaScript
5) Visual Code (IDE)
6) SQL

B. *Block Diagram*

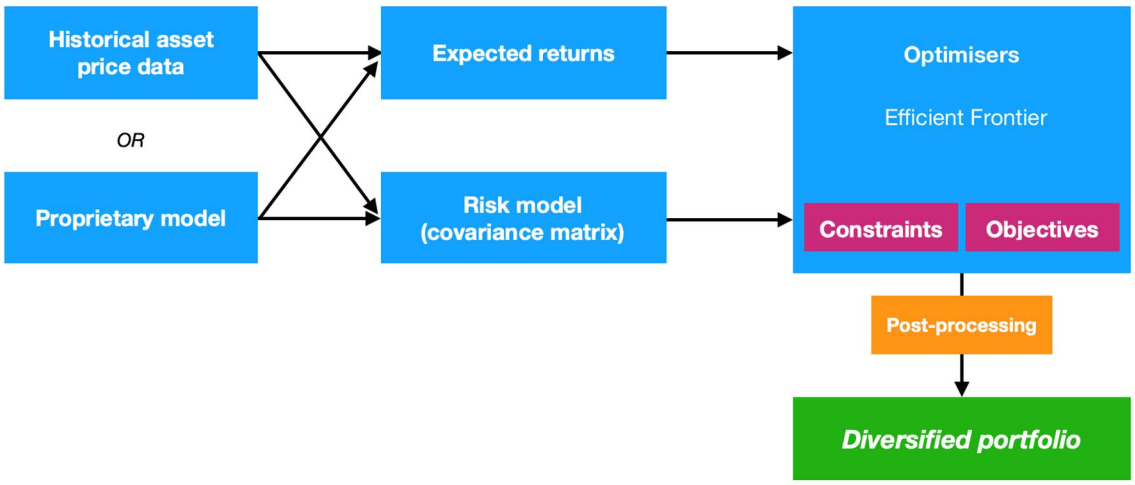

Figure 3.1 Block diagram

1) *Historical Asset Price data/ Proprietary Model:* Our project uses historical asset price data as one of the first inputs to calculate risk and return. The formula to calculate return is shown in the "Equations" section below.
2) *Expected Returns:* This forms the return(in %) which the investors are looking for. Since our optimized portfolio will have various assets, It will provide the mean return of n assets.
3) *Risk Model:* This model forms the other side of coin, the risk. The historical data is also used to calculate risk using the variance covariance matrix. It returns the risk of n assets.
4) *Optimisers:* This block combines the risk and returns to give out our final portfolio. The output will be in terms of volume percentages(n1- 50%, n2-24% and so on.). The block will have constraints and objectives in consideration before the final portfolio is given out. The efficient frontier is the plot of risk vs return which gives all possible combinations of risk and return for the given n asset classes.
5) *Post Processing:* This stage represents our data in a presentable format. Cumbersome percentages like 0.124578% will be reduced to 2 decimal points. Various errors will be handled.

C. *Algorithm*

1) The interface prompts the user to feed in credentials(Age, Occupation, etc.).
2) Make a spreadsheet including asset prices for the chosen frequency.
3) Convert prices into returns.
4) After we calculate the returns we calculate the "average (mean) return" for each asset.
5) Now we calculate the variance-covariance matrix.
6) Now we calculate both return and variance.
7) We now use the efficient frontier to find the minimum variance portfolio.
8) Finally, the page prints the tax shelter sections under which our user will be considered(Senior citizen, Govt employee, etc).

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D. Block Wise Design

1) *Historical Asset Price data/ Proprietary Model:* Our project uses historical asset price data as one of the first inputs to calculate risk and return. Historical prices portray the significance of understanding when assets have last had their values calculated, whether at a certain point or at various points during the trading day or in real time[10].
2) *Expected Returns:* This forms the return(in %) which the investors are looking for. Since our optimized portfolio will have various assets. It will provide the mean return of n assets. Expected return calculations are a key piece of financial theory, including in the well-known models of MPT[11].
3) *Risk Model:* This model forms the other side of the coin, the risk. The historical data is also used to calculate risk using the variance covariance matrix. It returns the risk of n assets. Model risk is a type of risk that occurs when a financial model is used to measure quantitative information such as a firm's market risks and the model fails or performs inefficiently and leads to adverse outcomes for the firm. A model is a system that relies on assumptions and economic or financial theories and techniques. The model processes data inputs into a quantitative output. Financial institutions use models to identify the theoretical value of stock prices[12]. Given that models can be useful tools in investment analysis, they are also prone to risks that can occur from the usage of inaccurate data, programming errors and misinterpretation of the model's outputs.
4) *Optimisers:* This block combines the risk and returns to give out our final portfolio. The output will be in terms of volume percentages(n_1- 50%, n_2-24% and so on.). The block will have constraints and objectives in consideration before the final portfolio is given out. The efficient frontier is the plot of risk vs return which gives all possible combinations of risk and return for the given n asset classes[13].
5) *The Efficient Frontier:* The efficient frontier, as described in the previous text, is the plot of risk vs. return. The risk is plotted against the x axis and returns against the y axis. Every point on the plot is a unique combination of risk and return and represents a unique portfolio[14]. The sample plot is shown below.

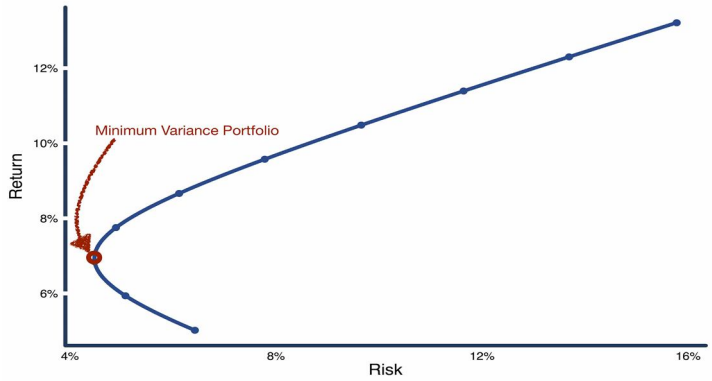

Figure 3.2 Minimum variance Portfolio

Our Implementation starts by giving our user option to login or sign up as the case maybe. The following are the screenshots of the pages.

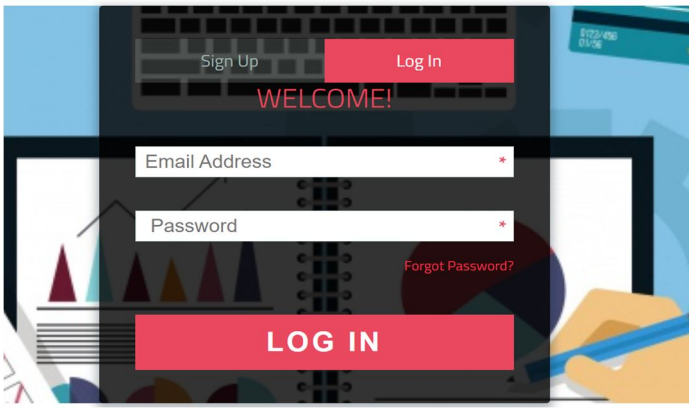

Figure 3.3 Login Screen

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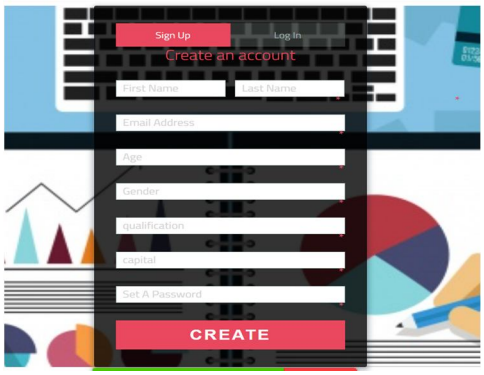


Figure 3.4 Signup Screen

Here is a sample user data which is being stored in our database.

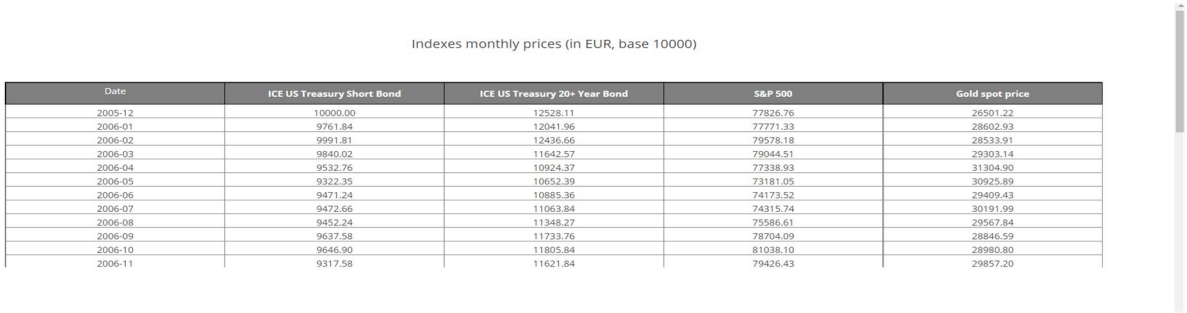
+ Options

	id	first_name	last_name	email	age	gender	qualification	capital	password	hash	active
Edit Copy Delete	1	jini	sanch	jinisha@gmail.com	21	f	stu	1000	$2y$10$Mmk1j.PDORD/Flroz.AgN.XKHsCVxdGJEfmNUuMhrhW...	8e82ab7243b7c66d768f1b8ce1c967eb	0

Check all With selected: Edit Copy Delete Export

Figure 3.5 Database Entry

We have integrated the live price data on our front end. Here's a test sample data which shows various securities on their respective dates. We have used the prevalent U.S indices to test our project which will ensure our algorithm. The index page is running on the local host (127.0.0.1). These are the monthly price data. Since we are expecting our investors to consider a time frame of at least 3 years, we can change our data source to annual historical security prices.

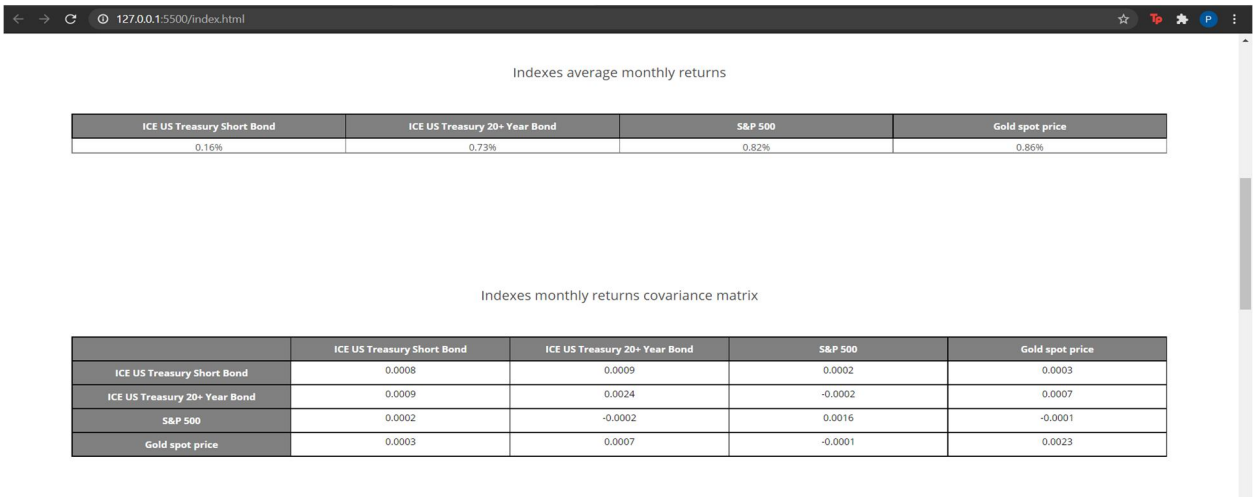


Indexes monthly prices (in EUR, base 10000)

Date	ICE US Treasury Short Bond	ICE US Treasury 20+ Year Bond	S&P 500	Gold spot price
2005-12	10000.00	12528.11	77826.76	26501.22
2006-01	9761.84	12041.96	77771.33	28602.93
2006-02	9991.81	12436.66	79578.18	28533.91
2006-03	9840.02	11642.57	79044.51	29303.14
2006-04	9532.76	10924.37	77338.93	31304.90
2006-05	9322.35	10652.39	73181.05	30925.89
2006-06	9471.24	10885.36	74173.52	29409.43
2006-07	9472.66	11063.84	74315.74	30191.99
2006-08	9452.24	11348.27	75586.61	29567.84
2006-09	9637.58	11733.76	78704.09	28846.59
2006-10	9646.90	11805.84	81038.10	28980.80
2006-11	9317.58	11621.84	79426.43	29857.20

Figure 3.6 Monthly prices

The returns have been tabulated as shown in the picture below.



127.0.0.1:5500/index.html

Indexes average monthly returns

ICE US Treasury Short Bond	ICE US Treasury 20+ Year Bond	S&P 500	Gold spot price
0.16%	0.73%	0.82%	0.86%

Indexes monthly returns covariance matrix

	ICE US Treasury Short Bond	ICE US Treasury 20+ Year Bond	S&P 500	Gold spot price
ICE US Treasury Short Bond	0.0008	0.0009	0.0002	0.0003
ICE US Treasury 20+ Year Bond	0.0009	0.0024	-0.0002	0.0007
S&P 500	0.0002	-0.0002	0.0016	-0.0001
Gold spot price	0.0003	0.0007	-0.0001	0.0023

Figure 3.7 Average monthly returns and variance covariance matrix

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In order to calculate the risk(variance) of the portfolio, we use the matrix formula and create a variance covariance matrix as shown above.

We then build the efficient frontier as shown in the picture below to calculate the minimum variance portfolio.

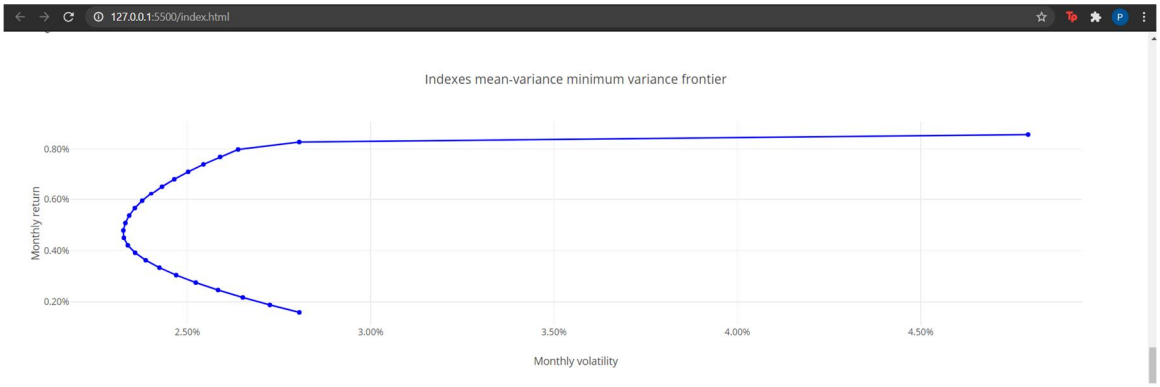

Figure 3.8 Mean variance frontier

E. Equations

The major equations involved are as follows:

The individual asset return is calculated as:

$$R_f = (V_f - V_i)/V_i \quad \text{.... } 3.1$$

Since it is relatively easier to understand the 2 assets portfolio formulas, we start by stating them[15]:

$$R_p = w_1 r_1 + w_2 r_2 \quad \text{.... } 3.2$$

$$\sigma^2_p = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2Cov_{1,2} \quad \text{.... } 3.3$$

The multiple assets portfolio involves matrix algebra. The formulas are:

$$\sigma_p^2 = \begin{pmatrix} w_1 & w_2 & w_3 & w_4 \end{pmatrix} \begin{pmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} & \sigma_{14} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} & \sigma_{24} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} & \sigma_{34} \\ \sigma_{41} & \sigma_{42} & \sigma_{43} & \sigma_{44} \end{pmatrix} \begin{pmatrix} w_1 \\ w_2 \\ w_3 \\ w_4 \end{pmatrix}$$

.... 3.4

$$R_p = w_1 r_1 + w_2 r_2 + \text{.....} + w_n r_n \quad \text{.... } 3.5$$

Where:

R_p = Portfolio return

σ^2_p = Portfolio variance

w_1 = weight of asset 1

w_2 = weight of the asset 2

σ_1= standard deviation(risk) of asset 2

σ_2 = standard deviation(risk) of asset 2

$Cov_{1,2}$ = the covariance of asset 1 and asset 2.

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IV. EXPERIMENTAL RESULTS

The final recommendation according to Markovitz's portfolio theory is summed up by a pie chart (the test data used in the previous section is given in fig 4.1. It effectively iterates the weights of total capital invested.

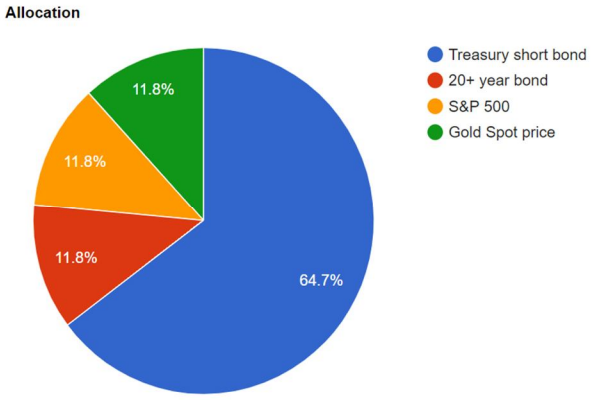

Figure 4.1 Asset Allocation

According to Indian rules and regulation of taxation, the short term and long-term capital gain are taxed in our project. The final output for the test data is given below.

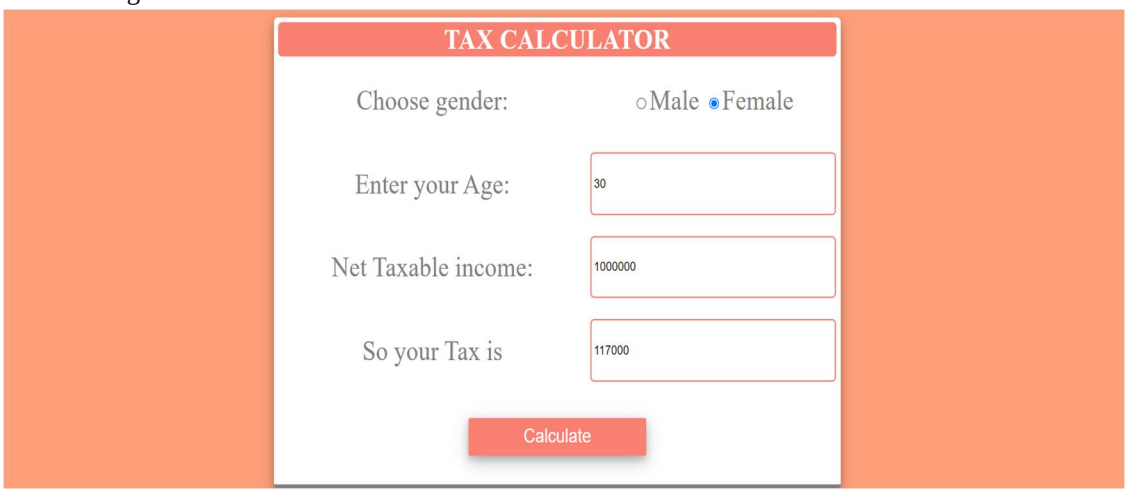

Figure 4.2 Tax Calculator Screen

Finally, our project enables common investors to manage wealth with a holistic approach.

V. CONCLUSION

The wealth management industry in India is prone for noteworthy expansion, given the advancements in technology and automation. To successfully tap this potential, a systematic approach is provided by the web page developed. A straightforward UI is deliberately employed strategically for better reach ability. The web page is developed in a way which can be proved beneficial to investors of all scales. The algorithms and calculations provide accurate results and suggest the most efficient way to invest based on the input provided by the user. This project has been developed keeping user's requirements in the centre as investment options advised by the web page are tailored according to specifications presented by the investor.

In accordance with investment strategies, an efficient way of asset management is employed in this project which proficiently administers and controls the assets possessed by the user. In the investment sector, the web page developed is an anthology of automated procedures which are otherwise carried out manually.

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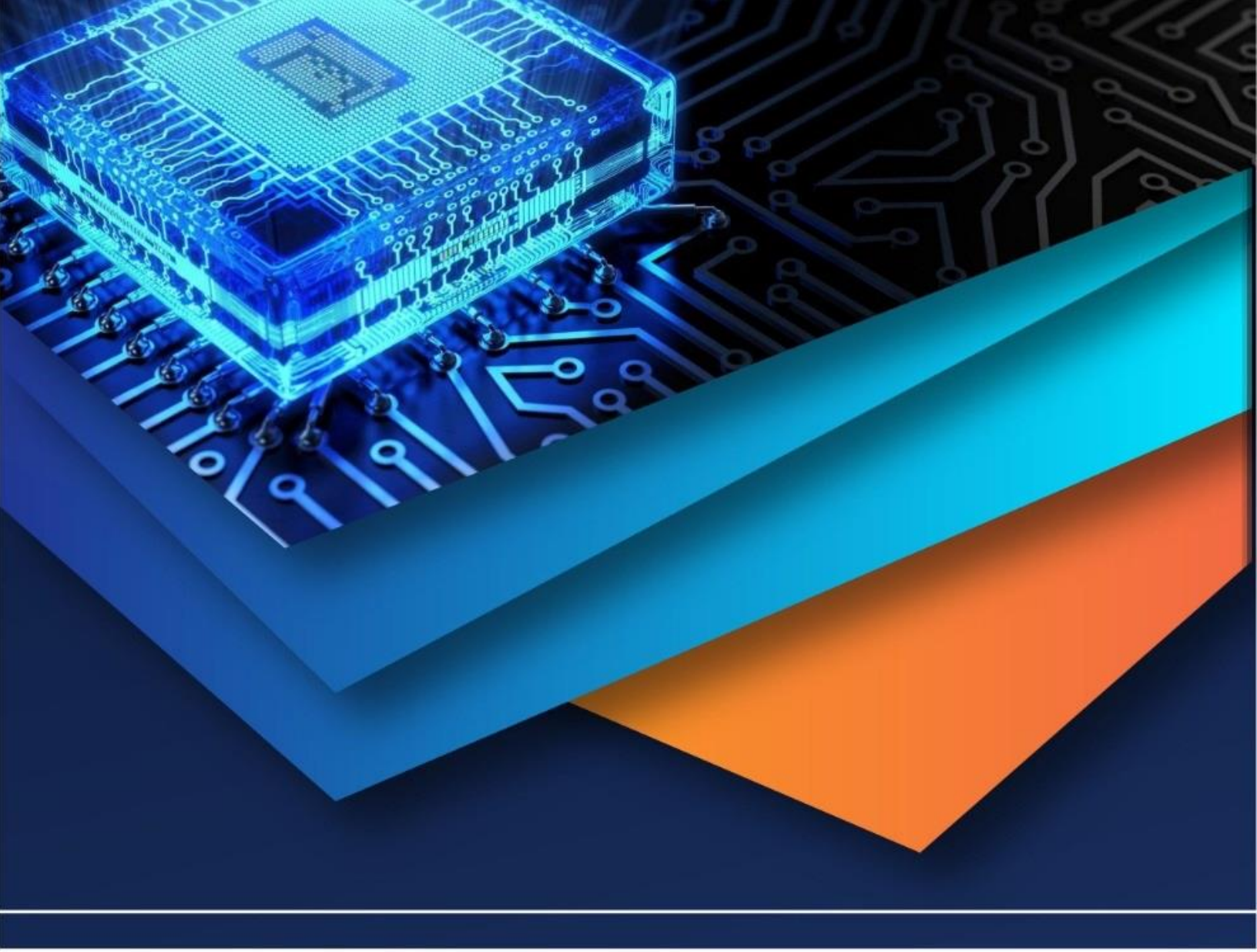

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