FINANCIAL RISK ANALYSIS

Milestone 2

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Problem2:

The dataset contains 6 years of information from 2014 to 2020 (weekly stock information) on the stock prices of 10 different Stocks of Indian companies Infosys, Indian Hotel, Mahindra & Mahindra, Axis Bank, SAIL, Shree Cement, Sun Pharma, Jindal Steel, Idea Vodafone, and Jet Airways. There are 314 observations and 11 variables.

The 10 numerical variables are the stock price data of 10 companies and 1 is an object variable which is date variable .

```
 #   Column               Non-Null Count  Dtype
---  ------               --------------  -----
 0   Date                 314 non-null    object
 1   Infosys              314 non-null    int64
 2   Indian_Hotel         314 non-null    int64
 3   Mahindra_&_Mahindra  314 non-null    int64
 4   Axis_Bank            314 non-null    int64
 5   SAIL                 314 non-null    int64
 6   Shree_Cement         314 non-null    int64
 7   Sun_Pharma           314 non-null    int64
 8   Jindal_Steel         314 non-null    int64
 9   Idea_Vodafone        314 non-null    int64
 10  Jet_Airways          314 non-null    int64
```

Table 1: Data information

There are no null values or duplicate records in the dataset

Lets see top 5 and bottom 5 records of the Dataset

	Date	Infosys	Indian_Hotel	Mahindra_&_Mahindra	Axis_Bank	SAIL	Shree_Cement	Sun_Pharma	Jindal_Steel	Idea_Vodafone	Jet_Airways
0	31-03-2014	264	69	455	263	68	5543	555	298	83	278
1	07-04-2014	257	68	458	276	70	5728	610	279	84	303
2	14-04-2014	254	68	454	270	68	5649	607	279	83	280
3	21-04-2014	253	68	488	283	68	5692	604	274	83	282
4	28-04-2014	256	65	482	282	63	5582	611	238	79	243

Table 2: Top 5 records of the Dataset

	Date	Infosys	Indian Hotel	Mahindra & Mahindra	Axis Bank	SAIL	Shree Cement	Sun Pharma	Jindal Steel	Idea Vodafone	Jet Airways
309	02-03-2020	729	120	469	658	33	23110	401	146	3	22
310	09-03-2020	634	114	427	569	30	21308	384	121	6	18
311	16-03-2020	577	90	321	428	27	18904	365	105	3	16
312	23-03-2020	644	75	293	360	21	17666	338	89	3	14
313	30-03-2020	633	75	284	379	23	17546	352	82	3	14

Table 3: Bottom 5 records of the Dataset

Lets look at 5 point summary of the dataset

	Infosys	Indian_Hotel	Mahindra_&_Mahindra	Axis_Bank	SAIL	Shree_Cement	Sun_Pharma	Jindal_Steel	Idea_Vodafone	Jet_Airways
count	314.000000	314.000000	314.000000	314.000000	314.000000	314.000000	314.000000	314.000000	314.000000	314.000000
mean	511.340764	114.560510	636.678344	540.742038	59.095541	14806.410828	633.468153	147.627389	53.713376	372.659236
std	135.952051	22.509732	102.879975	115.835569	15.810493	4288.275085	171.855893	65.879195	31.248985	202.262668
min	234.000000	64.000000	284.000000	263.000000	21.000000	5543.000000	338.000000	53.000000	3.000000	14.000000
25%	424.000000	96.000000	572.000000	470.500000	47.000000	10952.250000	478.500000	88.250000	25.250000	243.250000
50%	466.500000	115.000000	625.000000	528.000000	57.000000	16018.500000	614.000000	142.500000	53.000000	376.000000
75%	630.750000	134.000000	678.000000	605.250000	71.750000	17773.250000	785.000000	182.750000	82.000000	534.000000
max	810.000000	157.000000	956.000000	808.000000	104.000000	24806.000000	1089.000000	338.000000	117.000000	871.000000

Table 4: Data Summary

Draw Stock Price Graph(Stock Price vs Time) for any 2 given stocks with inference.

Lets us plot & see price trend over time for Infosys and Jindal

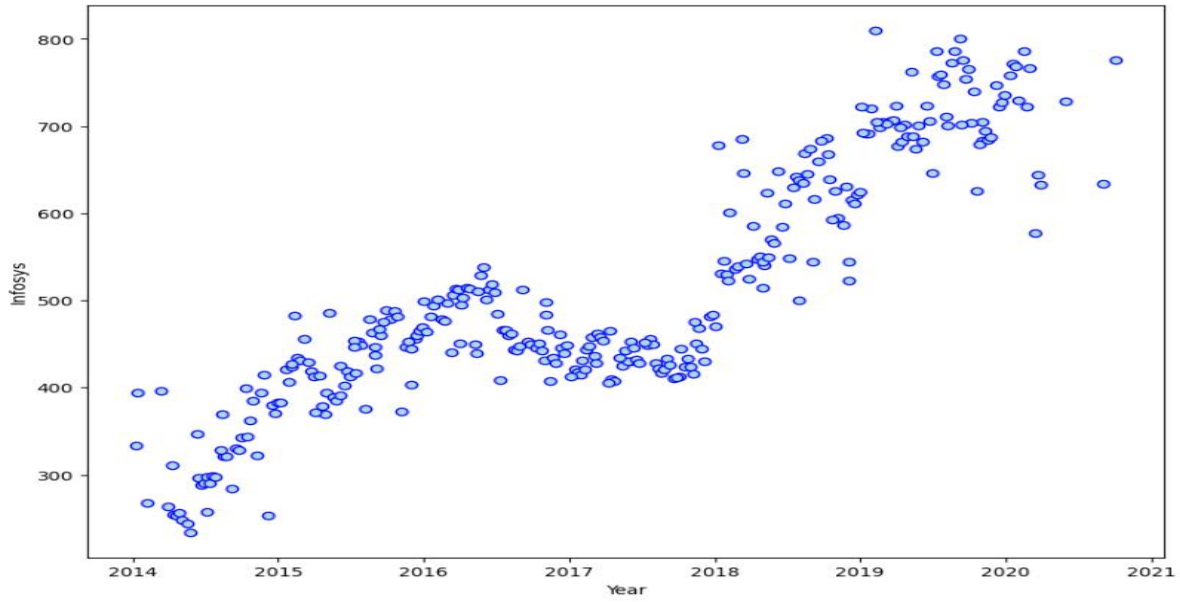

Figure 1:Infosys Stock Price over time

From the Stock Price Graph for Infosys, we can infer that there 3 major phases, Growth phase I, Stagnant phase and Growth Phase II

Growth phase I - From 2014- Mid 2016 stock prices of Infosys experienced a steady increase.

It started at price of 264 in 2014 and experienced a steady increase during this period. This growth phase suggests positive market sentiment and investors trust in the company, which lead to an upward trend in stock prices. Factors such as financial performance and improved business strategies may have contributed to this upward trend.

Stagnant Phase From 2016-2018 stock prices of Infosys experienced a stagnancy.

The stock prices of Infosys remained stagnant and there wasn't any significant growth. This phase could be due to market conditions, economic uncertainties, or company-specific challenges that impacted the stock prices. Investors may have adopted a wait-and-see approach, leading to a temporary plateau in stock prices.

Growth Phase II (2018-2020):

Following the period of inactivity, Infosys' stock prices began to rise gradually once more until 2020. The rebound in stock prices indicates that investors have a positive attitude towards the company and that the market is once again confident. This growth might have been attributed to various factors, including positive industry trends, effective corporate efforts, or improved financial performance.

The general pattern suggests that Infosys went through phases of expansion, then stagnation, and then expansion once more over the given period of time. It draws attention to the stock market's cyclical character and the impact of numerous outside influences on stock prices. Gaining a greater understanding of the stock performance can be achieved by analysing the factors that cause these swings, such as the company's finances, market dynamics, or macroeconomic situations.

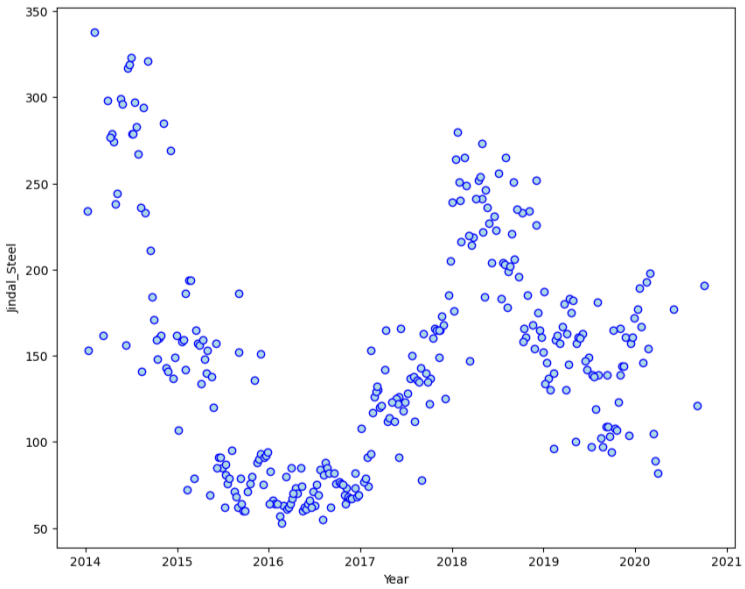

Figure 2 Jindal Stock Price over time

From the Stock Price Graph for Jindal, we can infer that there 4 major phases, Decline phase I, Stagnant phase, Growth phase I and Decline Phase II

Decline Phase I

There was a notable dip in Jindal Steel's stock price between 2014 and mid-2015. This fall implies that the market's perception of the company may have shifted negatively during this time. The drop in stock prices could have been caused by a number of things, including unfavourable market conditions, difficulties facing the industry, or problems unique to the company.

Stagnant Phase

The lack of fluctuation in Jindal Steel's stock price between mid-2015 and 2017 suggests a time of restricted price movement. The stock prices may have remained flat throughout this era due to market factors including stability or the absence of strong market drivers. During this time, investor opinion might have been hesitant or unclear regarding the company's prospects.

Growth Phase I

The rise in Jindal Steel's stock prices began in 2017 and persisted into 2018. This rise points to a possible improvement in the way the market views the company. Stock prices may have increased during this time due to a number of factors, including better financial performance, favourable industry trends, or profitable business plans.

Decline Phase II

Jindal Steel's stock prices steadily decreased until 2020 after peaking in 2018, with sporadic, insignificant rises. A possible loss of market confidence or unfavourable market conditions impacting stock prices are indicated by this decline. The downward trend may have been impacted by elements like the industry obstacles, company-specific concerns, or the recession in the economy.

Calculate Returns for all stocks with inference

The Stock return is calculated based on historical data of prices over a given period of time.

Investors can get an overview of how the stocks have performed over a period of time and can predict to some extent the behaviour in future using pattern of returns.

We can calculate Return as change in stock price written as a proportion of stock price in earlier time period .It can be expressed as percentage

R(t)=(P_t- P_{t-1})/ P_t

where R(t) is the return for a time period t. P_t is the Price of the Stock at time period t and P_{t-1} is Price of the Stock at time period t-1.

Alterative way to calculate return is by taking difference of log prices or Log of Price Ratios

R(t)=Log(P_t/P_{t-1}) or Log P_t-Log P_{t-1}

For our dataset, we will be using the difference of log prices to calculate the return for each Stock.

	Infosys	Indian_Hotel	Mahindra_&_Mahindra	Axis_Bank	SAIL	Shree_Cement	Sun_Pharma	Jindal_Steel	Idea_Vodafone	Jet_Airways
0	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
1	-0.026873	-0.014599	0.006572	0.048247	0.028988	0.032831	0.094491	-0.065882	0.011976	0.086112
2	-0.011742	0.000000	-0.008772	-0.021979	-0.028988	-0.013888	-0.004930	0.000000	-0.011976	-0.078943
3	-0.003945	0.000000	0.072218	0.047025	0.000000	0.007583	-0.004955	-0.018084	0.000000	0.007117
4	0.011788	-0.045120	-0.012371	-0.003540	-0.076373	-0.019515	0.011523	-0.140857	-0.049393	-0.148846

Table 5: Returns for all stocks

The tabular column above shows the returns for all the stocks for first 5 weeks .

- Stock returns, which show the proportionate change in the stock price over time, are commonly stated as a decimal or percentage. A gain or increase in value is shown by positive returns, whilst a loss or fall in value is indicated by negative returns. Negative stock returns are a sign that these investments come with more risk.
- When evaluating risk, analysing investment performance, choosing investments, and carrying out different financial analysis, these returns are essential. They're commonly utilized in the banking and investment fields and offer insightful information about the profitability and volatility of assets.
- Two crucial statistical metrics that may be utilized to further analyse the stocks are the mean return and the standard deviation of return. The standard deviation of a stock shows how far the stock deviates from its mean, and the mean return represents the average positive or negative return that a stock may produce.

Inference from the Returns

- Positive Returns: Positive returns have been demonstrated by the stocks of Infosys, Indian Hotel, Axis Bank, and Shree Cement. These stocks have shown strong performance over the examined timeframe, suggesting possible investor profitability.
- Negative Returns: The stocks of Idea Vodafone, Jet Airways, Jindal Steel, Sun Pharma, SAIL, and Mahindra & Mahindra have all demonstrated negative returns. Over the course of the analysis period, the value of these stocks has declined due to their poor performance.

- The unfavourable outcomes of Mahindra & Mahindra, SAIL, Sun Pharma, Jindal Steel, Idea Vodafone, and Jet Airways underscore the significance of carrying out exhaustive study and analysis prior to making investments in specific equities. These investments have a higher level of risk. To reduce the risk of poor returns, factors such the company's finances, the forecast for the industry, the calibre of management, and the state of the market should be carefully considered. They should also factor in causes of the poor performance, including market conditions, company-specific problems, or industry hurdles.
- Based on stock performance, it appears that several industries, including IT, Hospitality Industry , Banking Sector and Construction Industry, have demonstrated comparatively strong returns over the examined period. When building their portfolios, investors may take industry-specific trends and dynamics into account.
- Investors can lower overall risk by spreading their bets over a variety of sectors and industries, which may help to counteract any unfavourable performance from individual equities.

Calculate Stock Means and Standard Deviation for all stocks with inference

Stock Means: Also known as Average returns is mean value of the returns that the stock is making in a given time period. It provides an indication of the stock's overall performance during that time period

The formula for Stock Mean:

Stock Mean = (Sum of Returns) / (Number of Returns)

To calculate the stock mean, we sum up all the individual returns for the stock over the specified time period and divide the sum by the total number of returns.

Company	Average Returns
Infosys	0.002794
Indian_Hotel	0.000266
Mahindra_&_Mahindra	-0.001506
Axis_Bank	0.001167
SAIL	-0.003463
Shree_Cement	0.003681
Sun_Pharma	-0.001455
Jindal_Steel	-0.004123
Idea_Vodafone	-0.010608
Jet Airways	-0.009548

Table 6: Stock Means

- A mean return is the estimated profit or loss an investor can incur from an investment. It's an average of returns offered by the assets in the past and is used to predict the future returns it is expected to deliver, calculated on the basis of the past data available.
- Positive Mean values indicate there is positive average return over the time period and negative mean value indicate negative average returns across a time period.
- The mean values can help the investor in choosing the right stock to add to his portfolio

- Higher stock mean indicates higher average returns, while lower stock means indicates lower average returns .
- Shree cement has a highest stock mean of 0.003681 . Idea Vodafone a mean of -0.0106 which is the lowest.

Stock Standard Deviation returns is standard deviation calculated on the returns that the stock is making in a given time period

It is a measure of volatility of the stock .The more a stock's returns vary from the stock's mean return, the more volatile the stock is.Higher the volatility of the stock or higher the stock deviation from the mean, riskier the stock is.

The formula for Stock Standard Deviation:

Stock Standard Deviation = Square Root [(Sum of [(Return - Stock Mean) ^2]) / (Number of Returns)]

To calculate the stock standard deviation, we subtract the stock mean from each individual return, square the difference, sum up these squared differences, divide the sum by the total number of returns, and then take the square root of the result

Company	Standard Deviation
Infosys	0.035070
Indian_Hotel	0.047131
Mahindra_&_Mahindra	0.040169
Axis_Bank	0.045828
SAIL	0.062188
Shree_Cement	0.039917
Sun_Pharma	0.045033
Jindal_Steel	0.075108
Idea_Vodafone	0.104315
Jet_Airways	0.097972

Table 7: Stock Standard Deviation

- Larger standard deviations indicate greater price volatility or higher risk , while smaller standard deviations indicate lower volatility or risk.
- From the table above we can see that Idea Vodafone has the highest standard deviation of 0.104315 and hence higher volatility and riskier .
- On the other hand, Infosys has the lowest standard deviation of 0.035070 and hence lower volatility and less risky .
- The more fluctuation in stock returns , the higher its standard deviation – and the greater the investment risk. Whereas lesser returns fluctuations , the standard deviation is lower and less risky
- Knowing the standard deviation of a stock can help estimate future returns. However, future returns do not always match historical returns, and the standard deviation is based on historical returns. Nonetheless, standard deviation provides a good starting point to help determine the risk of stocks. These estimates of future returns also assume that the stock's returns are normally distributed. Normal distribution means an equal number of data points above and below the mean, forming a bell-shaped curve. If a stock had a particularly good or poor year to skew the results, this would cause the graph to be left or right skewed.
- A stock's returns can be estimated using the standard deviation based on a normally-distributed curve. This is because the standard deviation explains how many data points are within a specific range of the mean. Based on the standard deviation, set a trading range for the asset. For example, you might decide to only buy the asset when the price falls two standard deviations below the mean, or to sell when the price rises two standard deviations above the mean

- Calculating a mean return can help an investor quantify the relationship between the risk of a portfolio of securities and the potential return.
- However, a mean return does not guarantee a future rate of return and is only one tool that an investor should consider when evaluating an investment before purchasing it.
  Inference based on mean and standard deviation of Return:
- **Low Risk, Positive Returns**: The stock mean is positive and the stock standard deviation is low for Shree Cement and Infosys. Low return volatility and positive average performance are implied by this. Throughout the examined time period, these stocks have produced positive returns and relatively steady returns with little risk.
- **High Risk, Negative Returns**: High stock standard deviations and negative stock means are found in stocks such as Idea Vodafone, Jet Airways, Jindal Steel, and SAIL. This suggests negative average performance and significant return volatility. These equities have not produced positive returns throughout the examined time period and are linked to increased risk.
- **Moderate Risk, Positive Returns**: The stock mean is positive and the stock standard deviation is moderate for Axis Bank and Indian Hotel. This points to a positive average performance and modest return volatility. During the course of the analysis, these stocks have produced positive returns and relatively constant returns.
- **Low Risk, Negative Returns**: Stocks with negative stock mean and low stock standard deviation include Mahindra & Mahindra and Sun Pharma. This suggests a negative average performance and minimal return volatility. Although these stocks have consistent returns, which make them less risky, they have not produced gains over the examined timeframe.
- Stocks with higher mean and lesser standard deviation are the best investment options
- Stocks with lower mean and higher standard deviation should be avoided at all costs

Draw a plot of Stock Means vs Standard Deviation and state your inference

The table below lists Stock Returns means labelled as Average, and Stock returns standard deviation labelled as Volatility.

	Average	Volatility
Infosys	0.002794	0.035070
Indian_Hotel	0.000266	0.047131
Mahindra_&_Mahindra	-0.001506	0.040169
Axis_Bank	0.001167	0.045828
SAIL	-0.003463	0.062188
Shree_Cement	0.003681	0.039917
Sun_Pharma	-0.001455	0.045033
Jindal_Steel	-0.004123	0.075108
Idea_Vodafone	-0.010608	0.104315
Jet_Airways	-0.009548	0.097972

Figure 3: Stock Means Vs Standard Deviation

Let's plot the above values to better understand the relationship between these 2 variables with Average Returns on X axis and Standard Deviation(Volatility) of stocks on Y axis

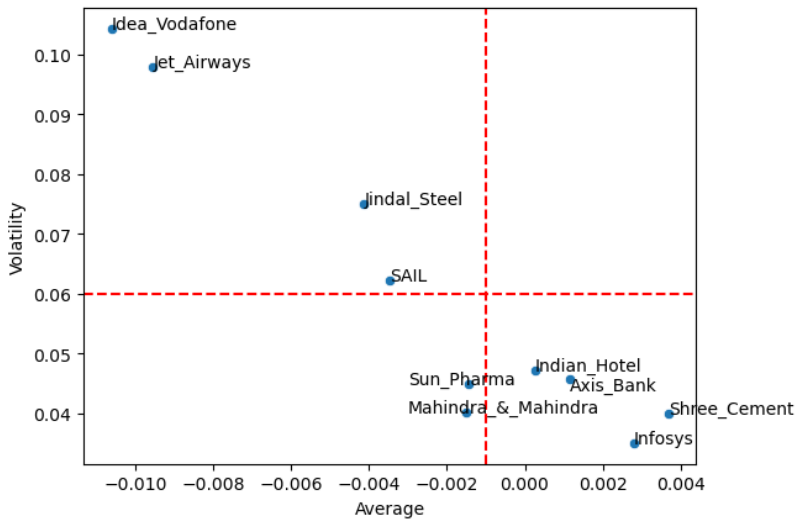

Figure 4:Plot of Stock Means Vs Volatility

- On X-axis, there is red dotted line that indicates the threshold set for mean of returns . Mean values higher than 0 indicate positive returns .We set the line at mean value = -0.001
- On Y-axis, we have set threshold values of Volatility to 0.06 . Values higher up in Y axis indicate high volatile stocks
  Stock Mean vs Stock standard Deviation graph divided is into four quadrants, here are some insights:

  High Means, Low Standard Dev Quadrant(Bottom Right): Low volatility and high average returns are characteristics of the stocks in this quadrant. With comparatively steady returns, these stocks have consistently performed well. Due to their ability to minimize volatility-related risk and perhaps yield higher returns, these companies may appeal to investors.

  Low Means, Low Standard Dev Quadrant(Bottom Left) Stocks in this quadrant have minimal volatility and poor average returns. Although they haven't produced particularly large positive returns, these stocks have had very steady gains. Even though these stocks might not provide significant growth potential, investors looking for stability and less risk may still want to give them some thought.

  Low Average, High Standard Dev Quadrant: (Top Left) High volatility and low average returns are characteristics of the stocks in this quadrant. These equities have bigger price fluctuations and, on average, have not produced appreciably positive returns. Since these companies are more volatile and have poor average performance, investors should proceed with caution when purchasing them.

  High Average, High Standard Dev Quadrant: (Top Right) Stocks in this region have significant volatility and high average returns. Because of their large price swings, these companies have a greater risk profile despite having the potential for large rewards. Higher risk-tolerant investors might find room for growth in these Stocks, but they need carefully evaluate and control the risks involved.

  Inferences from plot of Stock Means Vs Volatility

- Stocks with a lower returns & higher volatility falling in low average, high standard deviation quadrant gives poor returns with higher risks so, investors need to be cautious while investing in these stocks. Jet Airways and Idea Vodafone are performing badly, with negative returns and higher risks.
- Stocks with positive and higher returns and lower volatility falling in high average, low standard deviation quadrant are most rewarding with lesser risks. These stocks will be attracting more

investors as they have the potential to give stable returns with lesser risks. Stock of Infosys and Shree Cement have a higher means and less volatility. Indian Hotel and Axis Bank are also good investments

- Stocks with moderate returns and low volatility falling in Low Means, Low Standard Dev Quadrant will give average returns with moderate to low risks so, investors can consider investing in these stocks although they may not give high returns. Stock of Mahindra and Mahindra and Sun Pharma Cement have a lower means and less volatility.
- When choosing stocks from various quadrants, investors should take their risk tolerance, their investing objectives, and the risk-return trade-off into account.
- Being diversified across multiple quadrants allows for a mix of stable, lower-risk equities and possibly high-growth, higher-risk stocks, which can help minimize risk and maximize portfolio performance.

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Conclusions and Recommendations

	Average	Volatility
Infosys	0.002794	0.035070
Shree_Cement	0.003681	0.039917
Axis_Bank	0.001167	0.045828
Indian_Hotel	0.000266	0.047131

Table 8: Top Stocks with High Return and Lesser Risks

Conclusion

- To build a good stock portfolio we need stocks with higher return and a comparative or lower risk
- Appropriate risk return trade-off depends on factors like an investor's risk tolerance level, investment duration and the potential to replace lost funds. If an investor invests in equities for the long term, it provides the ability to recover from the risks in bear markets and participate in bull markets. Similarly, investing in equities for the short term can involve a higher proportion of risk.
- Risk return trade-offs are essential components of investment decisions and assessing the portfolio. Also, it helps analyse the portfolio holdings, their concentration and the appropriate mix to balance risk and return at a portfolio level.
- Stock with a highest return and lowest risk are the most preferred stocks. In this dataset, there are very few stocks
- Stock with a lower mean & higher standard deviation do not play a role in a portfolio, because they are highly volatile and also not giving good returns
- If customers looking for short term investments, they can go for stocks with high volatility and returns to ensure higher returns in short term.
- If customers are looking for long term investment must go for stocks with low volatility, but higher returns

From the Stock Mean Vs Volatility plots there are certain Recommendations

- Stocks of Idea Vodafone, Jet Airways, Jindal Steel, and SAIL have a high stock standard deviation and a negative stock mean, implying more volatility and no positive average returns. Due to their poor performance and high risk, these stocks should be approached with caution or avoided as investments.

- Shree Cement and Infosys exhibit low stock standard deviation and positive stock mean. These stocks have demonstrated consistent returns with positive average performance. These stocks are worth considering for investing since they are low risk, have stable returns, and have achieved positive average returns. However, it is recommended that you undertake extensive research and analysis on these stocks. Best recommendation would be Shree cement companies , its share price has been steadily increasing over the years and has highest mean of 0.003681 and low volatility of 0.039917. Second best recommendation would be Infosys, as the company's stock price has been increasing from the year 2018, though there was some inconsistency from mid-2016 to 2018 in the stock price. The mean value is the second –highest and had the lowest volatility among all stocks.
- Axis Bank and Indian Hotel have a moderate stock standard deviation and a favourable stock mean. These stocks have showed relatively consistent returns and positive average performance. These stocks may be considered for investing because they are low risk and have produced positive returns on average investment selections. Their returns are not as high compared to Shree cement and Infosys but they may be a good investment in the long run .
- Sun Pharma and Mahindra & Mahindra have low stock standard deviation and negative stock mean. These stocks have low volatility but no positive average returns. Due to their negative average performance, these stocks should be approached with caution, despite having lower risk associated with lower volatility.
- Finally, the recommendations take into account the risk-return trade-off as well as the stock performance characteristics. To limit risk and enhance portfolio performance, it is critical to undertake more research, analyse company fundamentals, evaluate market circumstances, and diversify investments across different stocks and sectors and to stay updated with latest information or seek guidance from an expert for personalized investment guidance.