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B.COM (A&F) – TYBAF

Project Topic:
Historical Data Analysis: Exploring Volatility Trends and
Correlation to Understand Portfolio Risk

FINANCIAL RISK MANAGEMENT (FRM)
SEM 5 - CIA 2

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Dashboard PDF

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Introduction:

As we all know the Financial Markets are highly dynamic, in terms of stock prices moving upwards and downwards. This causes uncertainty and risks for investors. Thus, in order to understand and manage risk, two key concepts are often studied: Correlation and Volatility. Correlation shows the relationship between two stocks and how they move together while Volatility measures the risk or variability of returns. (price changes).

In this project, I have used historical stock price data of selected companies to calculate the daily returns, volatility over 6-month (180D), 90 Days, 30 Days, and 1-year periods, and correlation between stocks. The results are visualized through dashboards and charts to aid interpretation.

Objective:

- Calculate daily returns and measure volatility for the selected companies.
- Compare volatility over different periods [1 year, 180 days (6M), 90 days, 30 days.]
- Compute correlation coefficient between stock pairs
- Create meaningful visualization (Line charts, correlation matrix, etc.)
- Reflecting why volatility varies and the role of correlation in portfolio risk.

Data Source and Resources

- **Data:** Historical Price data was exported from the Bloomberg Terminal at St. Xavier's College, Mumbai (Using HP <Go> function)
- **Resources/Tools:** Bloomberg Terminal, Excel and Power BI
- **Period of Analysis:** Last 1 year from **26th July, 2024 – 31st July, 2025**
- **Companies Selected:**
 1. Infosys (INFO)
 2. HDFC Bank (HDFCB)
 3. HUL (HUVR)
 4. Tata Motors (TTMT)
 5. Reliance Industries (RELIANCE)
 6. Sun Pharma (SUNP)
 7. Tata Steel (TATA)
 8. Bharti Airtel (BHARTI)
 9. Nestle (NEST)
 10. Asian Paints (APNT)

The rationale behind choosing these companies was to simply gauge a wide range of sectors in the Indian economy. This includes technology, FMCG, banking, automobiles, energy, pharmaceuticals, metals, telecom and consumer discretionary. It includes both cyclical (Tata Motors, Tata Steel) and defensive (HUL, Nestle, Asian Paints) stocks capturing different patterns of volatility. This project thus provides a realistic understanding of portfolio risk and diversification benefits.

Methodology

To achieve the objectives of the project, I followed a structured methodology. It started with data collection of prices and % change, followed by calculation of correlation and volatility and visualization in Excel using excel's inbuilt formulas for correlation and volatility. Each of these steps were carried out systematically to ensure accurate results.

In order to have better automation and an interactive dashboard I used the historical data saved in excel to perform correlation and volatility (Standard Deviation σ) calculation using complex DAX codes as Power BI doesn't have inbuilt correlation function.

Selection of Companies:

Ten different companies of the Indian stock market from different industry sectors such as IT (Infosys), FMCG (HUL, Nestle), Banking (HDFC), Automobile (Tata Motors), Energy (Reliance), Pharmaceutical (Sun Pharma), Tata Steel (Metals), Telecom (Airtel), and Consumer discretionary (Asian Paints) were chosen for analysis. Studying these companies provide realistic reflection of an investor's portfolio choices in the Indian Market.

Data Collection:

Historical data of the daily adjusted prices and the percentage change of the ten stocks was exported from the Bloomberg Terminal and compiled to one excel file. The data was collected for a year i.e., between 26th July, 2024 to 31st July, 2025.

Individual Stock and its daily price changes

Security	HDFCB IN Equity			Security	HUVR IN Equity			Security	TTMT IN Equity		
Start Date	26-07-2024 00:00			Start Date	26-07-2024 00:00			Start Date	26-07-2024 00:00		
End Date	31-07-2025 00:00			End Date	31-07-2025 00:00			End Date	31-07-2025 00:00		
Period	D			Period	D			Period	D		
Currency	INR			Currency	INR			Currency	INR		
Date	PX_LAST	Change	% Change	Date	PX_LAST	Change	% Change	Date	PX_LAST	Change	% Change
31-07-2025	2018.2	-7.6	-0.37516	31-07-2025	2521.2	83.8	3.43809	31-07-2025	665.95	-2.5	-0.374
30-07-2025	2025.8	4.2	0.20776	30-07-2025	2437.4	-16.2	-0.66025	30-07-2025	668.45	-23.9	-3.45201
29-07-2025	2021.6	13.1	0.65223	29-07-2025	2453.6	12	0.49148	29-07-2025	692.35	9.45	1.3838
28-07-2025	2008.5	3.9	0.19455	28-07-2025	2441.6	26.2	1.08471	28-07-2025	682.9	-4.5	-0.65464
25-07-2025	2004.6	-9.6	-0.47662	25-07-2025	2415.4	-22.4	-0.91886	25-07-2025	687.4	-13.1	-1.87009
24-07-2025	2014.2	-10.1	-0.49894	24-07-2025	2437.8	-12.6	-0.5142	24-07-2025	700.5	10.4	1.50703
23-07-2025	2024.3	17.2	0.85696	23-07-2025	2450.4	-29.3	-1.18159	23-07-2025	690.1	16.7	2.47995
22-07-2025	2007.1	6.6	0.32992	22-07-2025	2479.7	14.8	0.60043	22-07-2025	673.4	-14.05	-2.04379
21-07-2025	2000.5	43.1	2.2019	21-07-2025	2464.9	-24.7	-0.99213	21-07-2025	687.45	7.2	1.05843
18-07-2025	1957.4	-29.5	-1.48472	18-07-2025	2489.6	-20.2	-0.80485	18-07-2025	680.25	-1.45	-0.2127
17-07-2025	1986.9	-9.4	-0.47087	17-07-2025	2509.8	-7.8	-0.30982	17-07-2025	681.7	2.7	0.39764
16-07-2025	1996.3	0.8	0.04009	16-07-2025	2517.6	-9.3	-0.36804	16-07-2025	679	-5.4	-0.78901
15-07-2025	1995.5	12.5	0.63036								
14-07-2025	1992	0.7	0.03506								

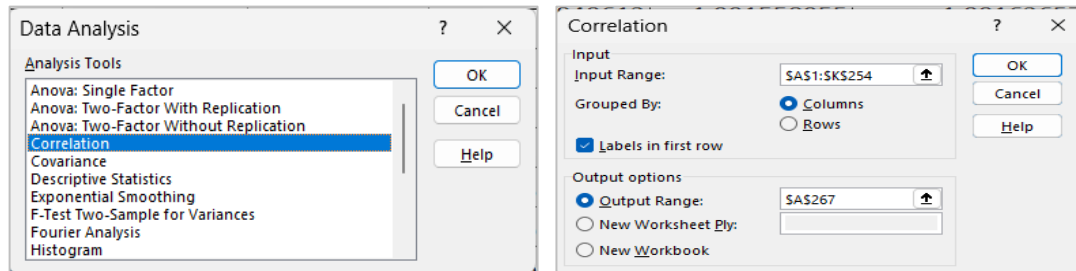
Consolidated file with Price Changes

A	B	C	D	E	F	G	H	I	J	K
Date	INFOSYS	HDFC	HUL	TATA M	RELIANCE	SUNPHARM	TATA STEEL	NESTLE	ASIAN PAINTS	BHARTI AIRTEL
31-07-2025	-0.65832785	-0.37516043	3.438089768	-0.37399955	-1.41124743	-1.56304072	-2.11948438	0.725969079	-0.815464856	-0.946910897
30-07-2025	0.35013543	0.207756233	-0.66025432	-3.45201127	-0.49396655	1.362174803	-0.20409425	0.35076674	0.59546117	0.745451702
29-07-2025	-0.15171504	0.652228031	0.491480996	1.383804364	2.125972903	0.487604277	1.258767535	-0.251199928	1.775724699	1.481246363
28-07-2025	0.019792835	0.194552529	1.084706467	-0.65464068	-0.29460372	0.188346086	-1.0840612	-1.991558955	1.001626573	-2.456267093
25-07-2025	-2.37037037	-0.47661603	-0.91886127	-1.87009279	-0.79834628	0.413711584	-1.25397602	-2.045562207	-0.675991667	0.092970404
24-07-2025	-1.39726897	-0.4989379	-0.51420176	1.507027967	-1.52323459	0.564635958	0.436198317	-5.317023445	-0.980887429	-0.396131289
23-07-2025	0.229167993	0.8569578	-1.18159455	2.47995248	0.835220838	0.2681764	-0.16560353	0.368324125	0.431253171	1.940423747
22-07-2025	-0.84579941	0.329917521	0.600430038	-2.043785	-1.10597788	-0.845003841	0.012268433	-1.176898811	-0.429401364	-0.125707102
21-07-2025	-0.11348591	2.20190048	-0.99212725	1.058434399	-3.21138211	-0.076759565	0.400320256	0.016179921	-0.293821357	0.43135192
18-07-2025	0.164193243	-1.48472495	-0.80484501	-0.21270354	-0.02709293	-0.575319948	1.544715447	0.943203626	-0.687815249	-1.497486916
17-07-2025	-1.51750731	-0.47087111	-0.30981888	0.397643594	-0.61927841	0.141093474	1.633509185	-0.443089431	-0.481227961	-0.345967159
16-07-2025	1.406407669	0.040090203	-0.36803989	-0.78901227	0.013464387	-1.534008683	-1.05031447	1.808550263	0.710256946	0.124082308
15-07-2025	0.974336114	0.630358043	0.409282365	1.467753892	0.114578419	2.668489243	-0.89753179	0.977892933	-0.33727515	0.692383778
14-07-2025	-1.54241645	-0.03528759	-0.11906652	-1.07069522	-0.76912788	0.633971292	0.375375375	-0.441023507	-1.541489013	-0.052031843
11-07-2025	-1.29347692	-1.12152328	4.617173227	-1.98389879	-1.45003955	0.571428571	-0.51039462	0.087448988	-0.489556136	-2.16849071
10-07-2025	-1.0956724	-0.2486078	-0.61896509	0.404157044	-0.11849901	-0.413322152	1.044025157	-1.087404234	-1.90883989	-2.73307917
09-07-2025	0.20514001	0.48065724	1.382060226	0.0573024	1.30067743	0.185251274	1.8226720	0.400446214	0.575545350	0.507280162

Correlation Analysis:

Excel

Once all the stock price changes were compiled, I began calculating correlation for all the stocks. Instead of calculating for each pair of stock individually, I used Excel's add-on Toolpak of data analysis. After selecting the table range, I was able to get the correlation between all 10 stocks. Below is the image showing correlation:



Correlation Matrix in Excel

	INFOSYS	HDFC	HUL	TATA M	RELIANCE	SUNPHARMA	TATA STEEL	NESTLE	ASIAN PAINTS	BHARTI AIRTEL
INFOSYS	1									
HDFC	0.196114312	1								
HUL	0.159958791	0.082247884	1							
TATA M	0.294667211	0.253429955	0.103953444	1						
RELIANCE	0.331791352	0.42718555	0.241161952	0.434197659	1					
SUNPHARMA	0.109331782	0.097867281	0.075451739	0.285306063	0.32364732	1				
TATA STEEL	0.306124899	0.31893001	0.045972522	0.514328386	0.493487565	0.309878186	1			
NESTLE	0.201598722	0.197042473	0.556723211	0.170342128	0.357420357	0.176868845	0.170933014	1		
ASIAN PAINTS	0.156880438	0.199267792	0.369786429	0.155945554	0.453440423	0.239478185	0.26089899	0.404619749	1	
BHARTI AIRTEL	0.351116209	0.273064059	0.223716841	0.250939675	0.381306308	0.325462106	0.328236824	0.323007588	0.236864116	1

Power BI

Unlike excel, Power Bi doesn't have an add-on tool for correlation. The formula used in Excel (CORREL function) and Power BI to calculate correlation is as follows:

<p>Excel</p> $r_{xy} = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}}$	<p>Power BI</p> $r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$
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Since the second correlation formula is significantly simpler and more accurate to compute in Power BI than the frequently used one, which requires individual variable calculations, I chose to use it instead.

Correlation Matrix in Power BI

Company	ASIAN PAINTS	BHARTI AIRTEL	HDFC	HUL	INFOSYS	NESTLE	RELIANCE IND	SUN PHARMA	TATA MOTORS	TATA STEEL
ASIAN PAINTS	1.00000	0.23686	0.19927	0.36979	0.15688	0.40462	0.45344	0.23948	0.15595	0.26090
BHARTI AIRTEL	0.23686	1.00000	0.27306	0.22372	0.35112	0.32301	0.38131	0.32546	0.25094	0.32824
HDFC	0.19927	0.27306	1.00000	0.08225	0.19611	0.19704	0.42719	0.09787	0.25343	0.31893
HUL	0.36979	0.22372	0.08225	1.00000	0.15996	0.55672	0.24116	0.07545	0.10395	0.04597
INFOSYS	0.15688	0.35112	0.19611	0.15996	1.00000	0.20160	0.33179	0.10933	0.29467	0.30612
NESTLE	0.40462	0.32301	0.19704	0.55672	0.20160	1.00000	0.35742	0.17687	0.17034	0.17093
RELIANCE IND	0.45344	0.38131	0.42719	0.24116	0.33179	0.35742	1.00000	0.32365	0.43420	0.49349
SUN PHARMA	0.23948	0.32546	0.09787	0.07545	0.10933	0.17687	0.32365	1.00000	0.28531	0.30988
TATA MOTORS	0.15595	0.25094	0.25343	0.10395	0.29467	0.17034	0.43420	0.28531	1.00000	0.51433
TATA STEEL	0.26090	0.32824	0.31893	0.04597	0.30612	0.17093	0.49349	0.30988	0.51433	1.00000

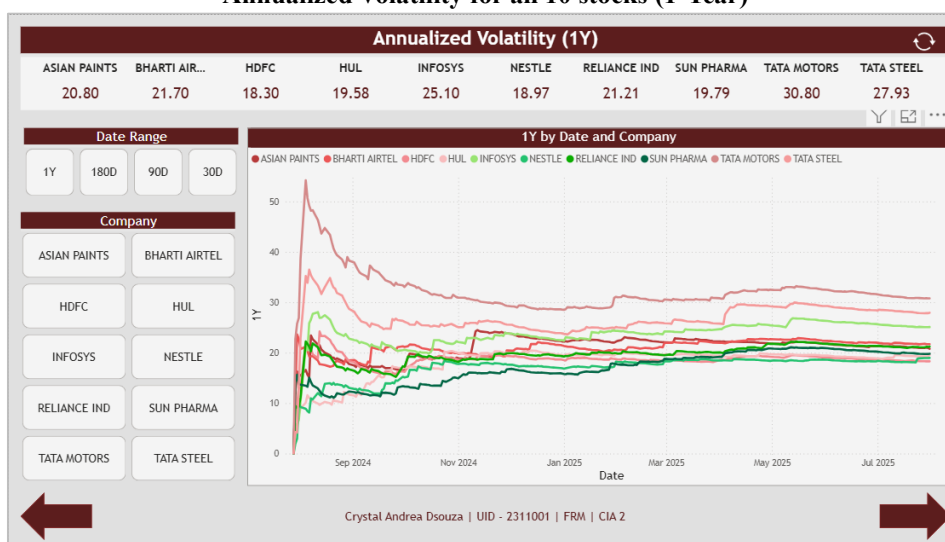
Volatility Analysis:

Volatility was measured using the Standard Deviation (σ) function **STDEVX.P** in Power BI, annualized by multiplying $\sqrt{252}$ (the approximate number of trading days in a year). In my analysis for a broader understanding, I have computed 4 sets of volatilities:

- **1-Year** volatility captures wider market swings and indicates **long-term risk**.
- **6-month (180D)** volatility provides a medium-term perspective on risk by illustrating the behaviour of stocks over a six-month period.
- **Short-term** swings that are **more reactive** to current events and news are known as **90-day** volatility.
- **30-day** volatility is **extremely short-term** perspective, pointing out short-term shocks and rapid market reactions.

Below illustration shows the Annualized Volatility for 1-Year, 6 Months (180D), 90 Days and 30 Days. One can view the volatility company-wise and range-wise for more analysis.

Annualized Volatility for all 10 stocks (1-Year)



Annualized Volatility for HUL and Tata Steel (1-Year)



Portfolio Volatility:

To dive deeper I tried to calculate the portfolio volatility of the stocks. Portfolio Volatility is the degree of price movement of a financial asset or group of securities. To calculate the volatility of my portfolio, I followed these steps:

- 1) **Assigning Weights:** In Power BI, I created a weight table for all 10 companies. Companies with low volatility were given higher weightage as they are stable while companies with high volatility were given lower weightage minimizing the overall risk.
- 2) **Weighted Daily Return:** I multiplied each stock's daily return (% Change) by its assigned weight so that the contribution of each stock to the portfolio return was adjusted as per its risk level.
- 3) **Portfolio Daily Return:** Further to this, I added up all the weighted returns of the companies to get the portfolio's daily return.
- 4) **Portfolio Volatility (Annualized):** Last and Final, I calculated the standard deviation of the portfolio's daily returns and multiplied it by $\sqrt{252}$ - which are the trading days in a year. This shows the annualized portfolio volatility, which shows how risky the overall portfolio is in that one year.

Step 1

Company	Weight
ASIAN PAINTS	0.10
BHARTI AIRTEL	0.10
HDFC	0.15
HUL	0.12
INFOSYS	0.08
NESTLE	0.15
RELIANCE IND	0.10
SUN PHARMA	0.10
TATA MOTORS	0.05
TATA STEEL	0.05

Step 2

Date	Company	% Change	Weighted Return
31 July 2025	HDFC	-0.375160430447226	-0.0562740645670839
30 July 2025	HDFC	0.207756232686983	0.0311634349030474
29 July 2025	HDFC	0.652228030868803	0.0978342046303204
28 July 2025	HDFC	0.194552529182884	0.0291828793774326
25 July 2025	HDFC	-0.476616026213888	-0.0714924039320832
24 July 2025	HDFC	-0.498937904460797	-0.0748406856691195
23 July 2025	HDFC	0.856957799810674	0.128543669971601
22 July 2025	HDFC	0.32991752061984	0.0494876280929761
21 July 2025	HDFC	2.20190048022887	0.33028507203433
18 July 2025	HDFC	-1.4847249484121	-0.222708742261815

Step 3

```
1 Portfolio Daily Return =  
2 SUM ( 'Stock Unpivot'[Weighted Return] )
```

Portfolio Daily Return
-1.79

Step 4

```
1 Portfolio Volatility (Ann) =  
2 STDEVX.P ( VALUES ( 'Stock Unpivot'[Date] ),  
3 [Portfolio Daily Return] ) * SQRT ( 252 )
```

Portfolio Volatility (Ann)
12.42

Results & Visualizations

Correlation Matrix:

A Correlation Matrix is a visual that showcases the relationship between 2 variables, in this case 2 stocks. It is a market sensitivity measure that shows how various risk factors move together. Correlation ranges for +1 to -1 and any two variables (stocks) that have a high correlation i.e., closest to +1 increases the risk in your entire portfolio overall lessening the benefits of diversification. The darker red cells in the heatmap below show stronger correlations.

In case of the below correlation table, the assets that are **highly** correlated (**above 0.40**) are HUL-Nestle (0.55), Tata Motors-Tata Steel (0.51), Reliance-Tata Steel (0.49), Reliance-Asian Paints (0.45). These stocks are cyclical in nature, meaning they move together along with the market conditions. Whereas, **lowly** correlated stocks (**below 0.20**) like HUL-Tata Steel (0.04), Infosys-Sun Pharma (0.10), Sun Pharma-HUL (0.07) don't move in sync as they are defensive stocks. Thus, adding these together in a portfolio can **reduce risk**. Bharti Airtel-Infosys (0.35), Nestle-Infosys (0.20), Asian Paints-Nestle (0.40) are moderate correlations that show slight movement together but still minimal risk.

Company	ASIAN PAINTS	BHARTI AIRTEL	HDFC	HUL	INFOSYS	NESTLE	RELIANCE IND	SUN PHARMA	TATA MOTORS	TATA STEEL
ASIAN PAINTS	1.00000	0.23686	0.19927	0.36979	0.15688	0.40462	0.45344	0.23948	0.15595	0.26090
BHARTI AIRTEL	0.23686	1.00000	0.27306	0.22372	0.35112	0.32301	0.38131	0.32546	0.25094	0.32824
HDFC	0.19927	0.27306	1.00000	0.08225	0.19611	0.19704	0.42719	0.09787	0.25343	0.31893
HUL	0.36979	0.22372	0.08225	1.00000	0.15996	0.55672	0.24116	0.07545	0.10395	0.04597
INFOSYS	0.15688	0.35112	0.19611	0.15996	1.00000	0.20160	0.33179	0.10933	0.29467	0.30612
NESTLE	0.40462	0.32301	0.19704	0.55672	0.20160	1.00000	0.35742	0.17687	0.17034	0.17093
RELIANCE IND	0.45344	0.38131	0.42719	0.24116	0.33179	0.35742	1.00000	0.32365	0.43420	0.49349
SUN PHARMA	0.23948	0.32546	0.09787	0.07545	0.10933	0.17687	0.32365	1.00000	0.28531	0.30988
TATA MOTORS	0.15595	0.25094	0.25343	0.10395	0.29467	0.17034	0.43420	0.28531	1.00000	0.51433
TATA STEEL	0.26090	0.32824	0.31893	0.04597	0.30612	0.17093	0.49349	0.30988	0.51433	1.00000

Annualized Volatility:

In this page of the dashboard, you can see the annualised volatility of selected companies over a set of periods, helping users to analyse the risks associated with each stock.

The Top Cards (KPIs): These cards display the annualised volatility over 1-year period for all 10 companies. For Example, Tata Motors (30.80%) and Tata Steel (27.93%) have high levels of volatility indicating high risk as compared to other stocks like HDFC (18.30%) and Nestle (18.97%) which have lower and stable volatility values.

Filters and Slicers (Side Pannel): The Date Range Selector helps to switch between different periods (1Y, 180D, 90D, 30D) to display the volatility over different time periods. The Company slicer allows users to select the companies individually as well as in groups allowing comparative assessment across companies.

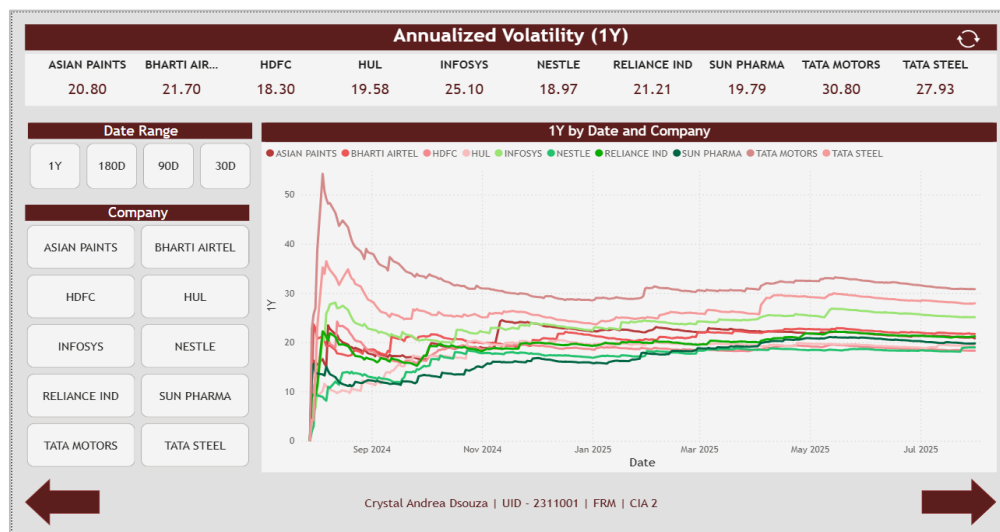
Line Chart (Main Panel): The line chart shows how the annualized volatility of each company has changed over time.

The pink lines (e.g., Tata Motors, Tata Steel) are raised, indicating continuously higher volatility levels, highlighting their cyclical and market-sensitive nature.

The green lines (for Nestle and Sun Pharma) continue at lower levels, indicating defensive and largely steady companies.

The early spikes observed in July-August 2024 suggest a period of market stress or extreme uncertainty, after which volatility gradually stabilizes.

Hence, this visualization allows investors to clearly differentiate between **cyclical vs. defensive stocks** and supports portfolio diversification decisions.

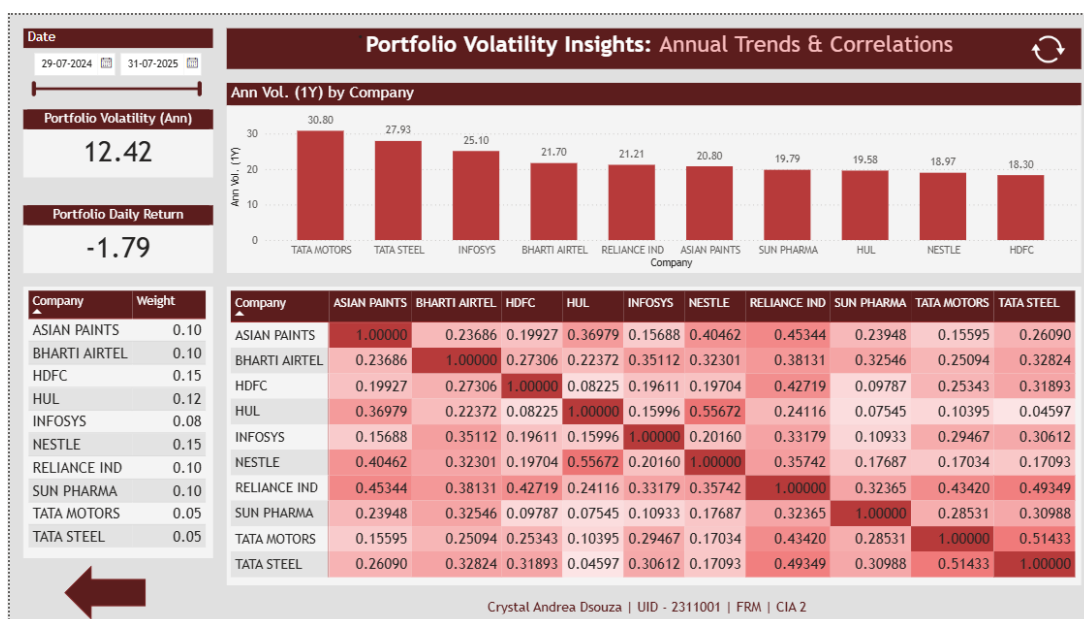


Portfolio Volatility Insights:

This dashboard gives a complete picture of how risky (volatile) our portfolio really is overall. Along with volatility it also shows the relation between the stocks and how they move together (correlation).

Portfolio metrics: Portfolio Volatility and Portfolio Daily Return

- Portfolio Volatility (Ann): the annualised volatility of the portfolio is 12.42% which is comparatively lower than the individual volatilities of the individual stocks which range from 18% - 31%. This shows that the diversification is working and investment in a portfolio like this is less risky.
- Portfolio Daily Return: As per my calculations, the portfolio's daily return is -1.79 which shows that in the selected time from (i.e., 1 year) the portfolio is slightly underperforming. Users can use the Date slicer to change the time frame.



The portfolio's risk level is moderate (12.42%) because it combines high-volatility cyclical stocks (such as Tata Motors, Tata Steel, and Infosys) with low-volatility defensive stocks (such as HDFC, Nestle, HUL, and Sun Pharma).

The correlation study indicates that certain categories of stocks (such as metals or FMCG) move in simultaneously, which could raise risk during a sector decline.

For greater diversity, it may be advantageous to reduce exposure to stocks that are both highly volatile and highly correlated, while investing more in stable, less correlated stocks.

Conclusion

In conclusion, this project definitely gave me a practical understanding of concepts like volatility and correlation and how they play out in the real financial world. Looking back at the stock prices and the volatility, some companies show high volatility. That's because of various factors like the industry they are in, the size of the company or just the market news. For example, companies like HUL and Nestle (FMCG) will react more mildly to the changes compared to Tata Motors or Reliance.

Correlation also plays an important role in portfolio risk. If two stocks move in the same direction most of the time, then investing in both of them doesn't reduce the risk of the market changes. But, if they are negatively correlated, the portfolio tends to be more balanced reducing the overall risk.

Reflections:

This project was really interesting to work on. The results clearly showed that diversification really works in a portfolio. The difference between short-term and long-term volatility was another key learning for me. Choosing the correct time frame is very important in your analysis if your ultimate goal is to make fruitful investment decisions. While 30-day or 90-day periods captured market shocks and reactions, the 1-year measure gave a more stable, long-term view.

In terms of skills, I not only improved my knowledge of Excel, but I also learned how to use complex DAX formulae in Power BI to automate correlation and volatility calculations, which I had previously assumed would be difficult. Building dashboards allowed me to communicate outcomes in a much clearer and more interactive manner, which I can see being really beneficial in the workplace. Since Power BI is dynamic, one can upload a number of companies data and just click on refresh and everything will be updated dynamically.

Overall, this project taught me that portfolio building is more than just selecting good stocks; it is also about risk management through diversification and understanding how stocks interact with one another. More importantly, it demonstrated how financial concepts, data analysis, and visualization tools work together to improve investment decision-making.

The End