
FRA CODED PROJECT – PART B

Business Report

DSBA

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Business Context & Data Dictionary

Context

Investors face market risk, arising from asset price fluctuations due to economic events, geopolitical developments, and investor sentiment changes. Understanding and analysing this risk is crucial for informed decision-making and optimizing investment strategies.

Objective

The objective of this analysis is to conduct Market Risk Analysis on a portfolio of Indian stocks using Python. It uses historical stock price data to understand market volatility and riskiness. Using statistical measures like mean and standard deviation, investors gain a deeper understanding of individual stocks' performance and portfolio variability.

Through this analysis, investors can aim to achieve the following objectives:

- Risk Assessment: Analyse the historical volatility of individual stocks and the overall portfolio.
- Portfolio Optimization: Use Market Risk Analysis insights to enhance risk-adjusted returns.
- Performance Evaluation: Assess portfolio management strategies' effectiveness in mitigating market risk.
- Portfolio Performance Monitoring: Monitor portfolio performance over time and adjust as market conditions and risk preferences change.

Data Description

The dataset contains weekly stock price data for 5 Indian stocks over an 8-year period. The dataset enables us to analyze the historical performance of individual stocks and the overall market dynamics.

Rubric Question 1: Data Overview

Dataset Summary

- **Load dataset & display top 5 rows:** -

	Date	ITC Limited	Bharti Airtel	Tata Motors	DLF Limited	Yes Bank
0	28-03-2016	217	316	386	114	173
1	04-04-2016	218	302	386	121	171
2	11-04-2016	215	308	374	120	171
3	18-04-2016	223	320	408	122	172
4	25-04-2016	214	319	418	122	175

Figure 1: Top 5 rows of the dataset

- There are **418 rows & 6 columns** in the dataset
- **Checking datatypes:** -

```
Data columns (total 6 columns):
#   Column      Non-Null Count  Dtype
---  -
0   Date         418 non-null    object
1   ITC Limited   418 non-null    int64
2   Bharti Airtel 418 non-null    int64
3   Tata Motors   418 non-null    int64
4   DLF Limited   418 non-null    int64
5   Yes Bank      418 non-null    int64
dtypes: int64(5), object(1)
```

Figure 2: Datatypes in the Dataset

- ✓ There are 6 columns - 5 Int64 (numeric) & 1 Object datatypes in the dataset.

- **Check Missing Values:** -
 - ✓ No missing values found.

```
Missing values in the dataset:-

Date         0
ITC Limited   0
Bharti Airtel 0
Tata Motors   0
DLF Limited   0
Yes Bank      0
```

Figure 3: Missing Value-check

- **Convert 'Object' to 'DateTime' datatype:** -
 - ✓ Below is the datatype summary post conversion: -

```
Data columns (total 6 columns):
#   Column      Non-Null Count  Dtype
---  -
0   Date         418 non-null    datetime64[ns]
1   ITC Limited   418 non-null    int64
2   Bharti Airtel 418 non-null    int64
3   Tata Motors   418 non-null    int64
4   DLF Limited   418 non-null    int64
5   Yes Bank      418 non-null    int64
dtypes: datetime64[ns](1), int64(5)
```

Figure 4: Datatypes in the Dataset post Datatype-conversion

Rubric Question 2: Stock Price Graph Analysis

Scatterplot – Stock Price vs Time

- Plot Scatterplots of prices of all 5 stocks against time to analyse the trend: -

1. ITC

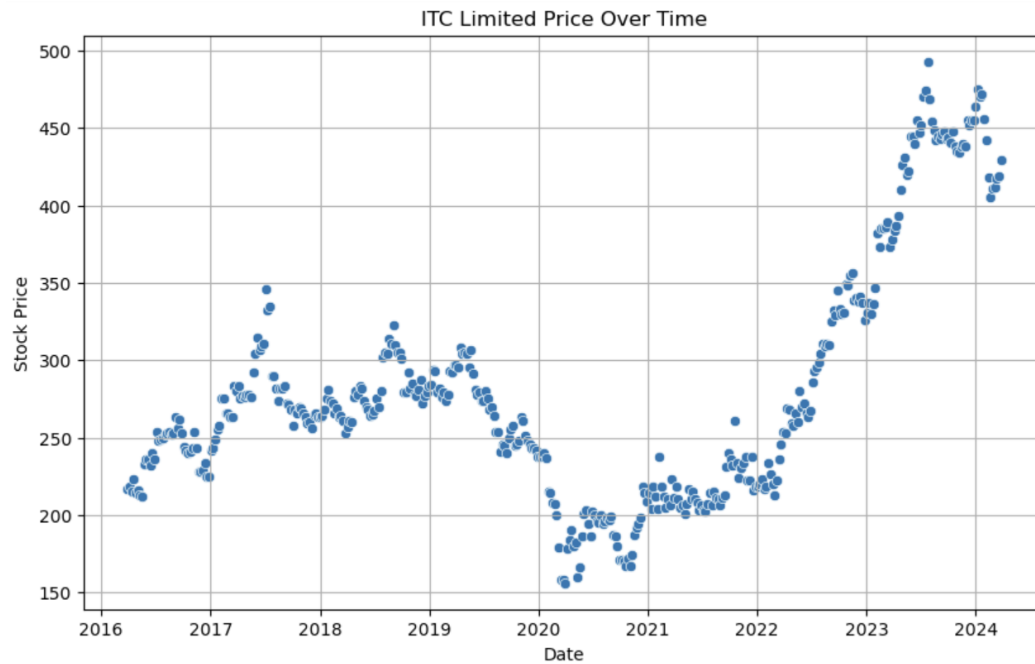


Figure 5: Scatterplot | ITC Stock Price vs Time

2. Bharti Airtel

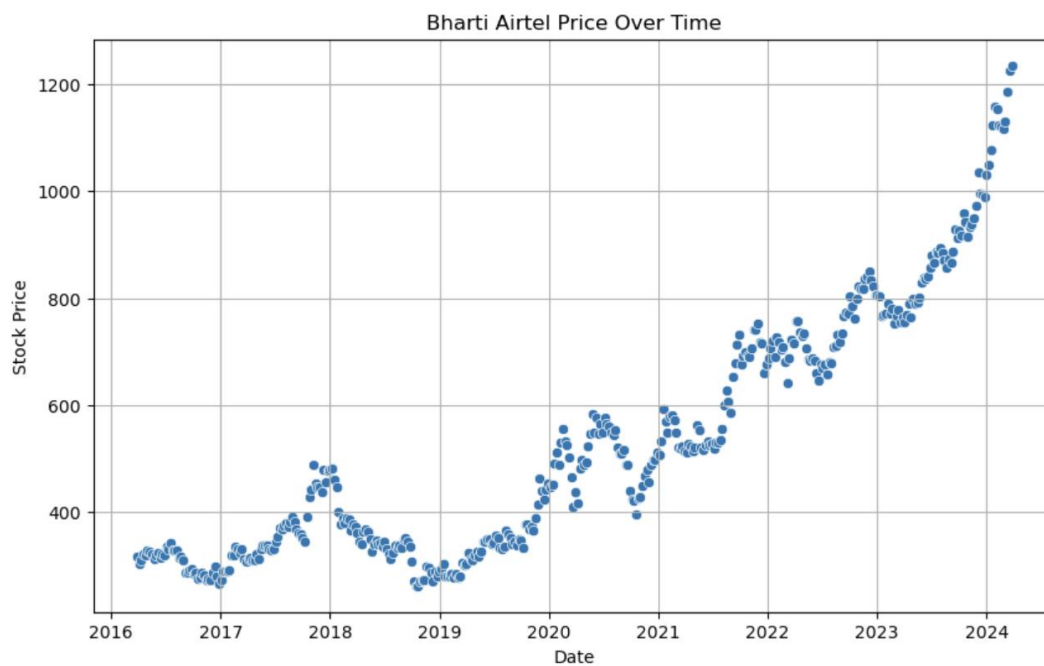


Figure 6: Scatterplot | Bharti Airtel Stock Price vs Time

3. Tata Motors

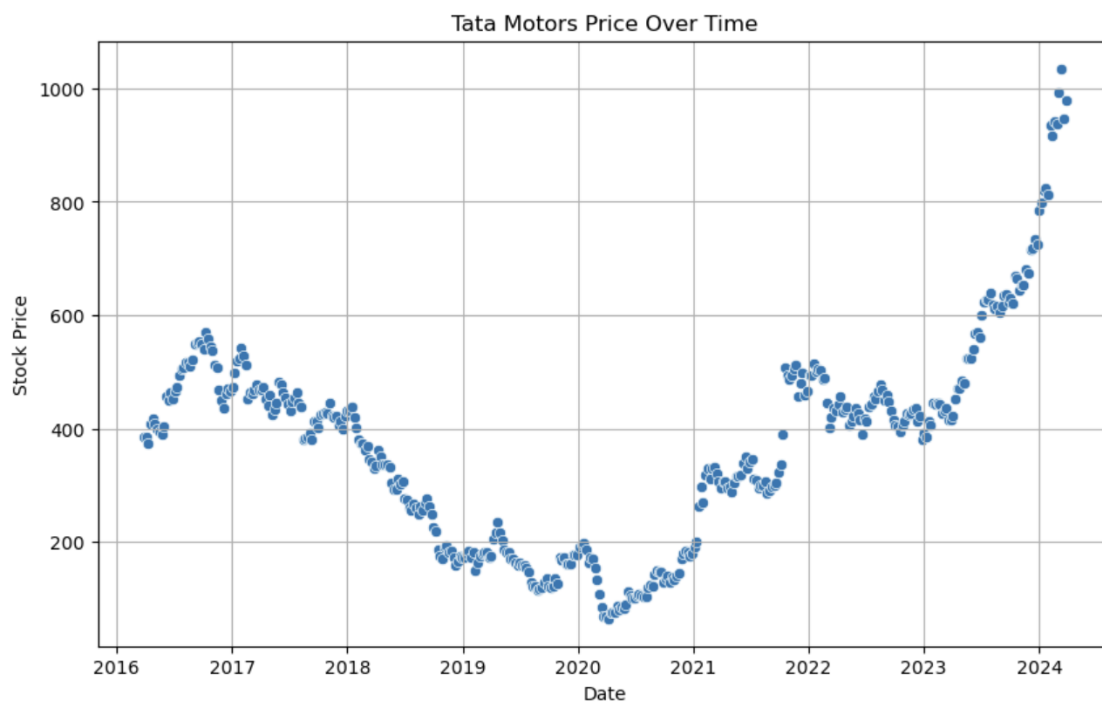


Figure 7: Scatterplot | Tata Motors Stock Price vs Time

4. DLF Limited

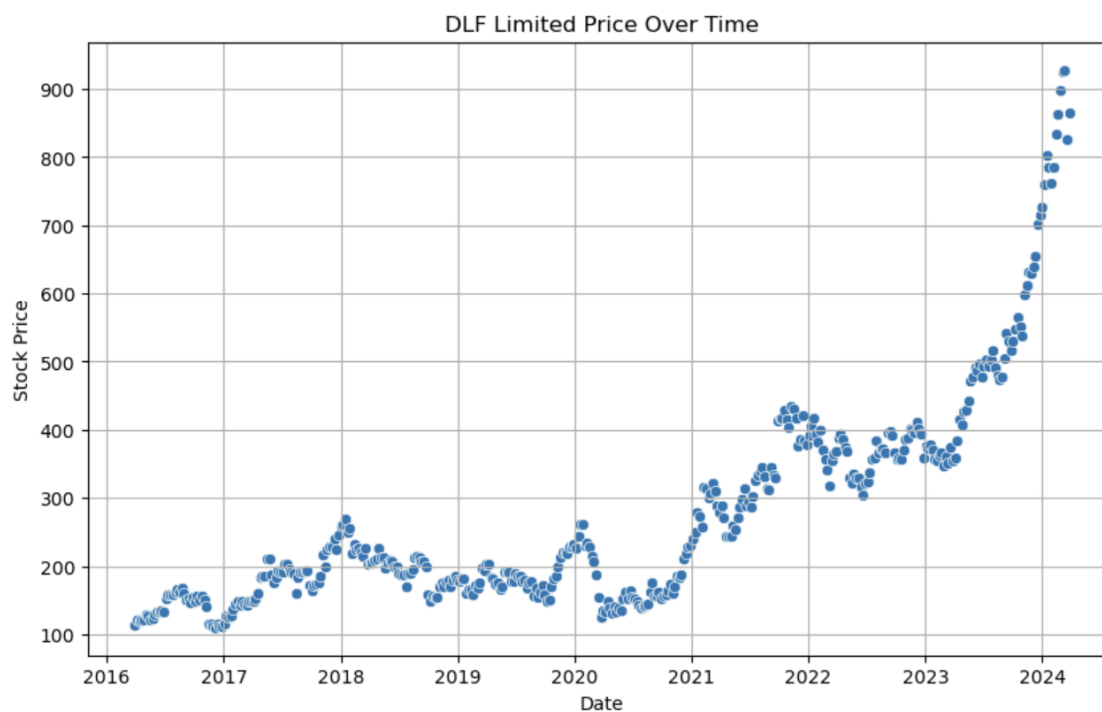


Figure 8: Scatterplot | DLF Limited Stock Price vs Time

5. Yes Bank



Figure 9: Scatterplot | Yes Bank Stock Price vs Time

Observations

- Below are the observations for stock price trends: -

1. ITC

- ✓ **2016–2017:** Gradual uptrend from ~₹210 to ₹280, reflecting steady growth.
- ✓ **2017–2019:** Spike above ₹340 followed by sideways movement (~₹270–₹300), indicating market consolidation.
- ✓ **2019–2020:** Decline to ~₹160 during the COVID crash, showing vulnerability to market shocks.
- ✓ **2020–2021:** Recovery to ₹220, but relatively flat.
- ✓ **2022–2024:** Strong bullish rally from ₹220 to ~₹480, signalling renewed investor confidence and possible business turnaround
- ✓ **Overview:** ITC has evolved from a **slow and stable stock** into a **high momentum performer** post-2022. The recent trend suggests a **strategic shift or re-rating** by the market. Long-term investors benefited from low volatility and recent sharp upside.

2. Bharti Airtel

- ✓ **2016–2018:** Gradual rise from ~₹300 to ~₹470. Reflects early recovery phase with increased sector optimism.
- ✓ **2018–2019:** Decline back to ~₹300, indicating pressure from competition or regulatory environment (e.g., telecom AGR issues).
- ✓ **2020–2021:** Strong upward movement to ~₹650–₹700. Likely driven by data boom, market consolidation, and tariff hikes.
- ✓ **2022–2024:** Sustained rally to over ₹1200. Demonstrates strong investor confidence and financial performance, possibly due to 5G rollout, rising ARPU, and subscriber growth.
- ✓ **Overview:** Bharti Airtel shows a **strong long-term uptrend** with phases of correction. Post-2020, the stock gained momentum, reflecting its solid position in a consolidating telecom market and digital expansion.

3. Tata Motors

- ✓ **2016–2017:** Strong uptrend from ~₹400 to above ₹550. Reflects global optimism and strong Jaguar Land Rover (JLR) performance.
- ✓ **2018–2020:** Steady decline from ₹450 to below ₹100. Indicates impact of global slowdown, JLR headwinds, and COVID-19 disruption.
- ✓ **2021–2022:** Recovery to ~₹500, driven by EV narrative and turnaround expectations.
- ✓ **2023–2024:** Sharp rally above ₹1000. Likely fuelled by EV momentum, improved financials, and renewed investor confidence.
- ✓ **Overview:** Tata Motors experienced a **deep cyclical downturn followed by a strong revival**, emerging as a high-beta stock capitalizing on EV growth and global auto recovery.

4. DLF Limited

- ✓ **2016–2019:** Gradual rise from ~₹110 to ~₹220. Followed by a modest decline toward ₹160–₹180. Reflects cyclical nature of the real estate sector.
- ✓ **2020:** Sharp drop during COVID-19 to ~₹120. Impacted by lockdowns and weak demand outlook.
- ✓ **2021–2022:** Strong recovery to ₹400+ levels. Indicates revival in housing demand, low interest rates, and policy support.
- ✓ **2023–2024:** Steep rally to ~₹900. Reflects a bullish real estate cycle, strong sales performance, and investor re-rating.
- ✓ **Overview:** DLF transitioned from a **range-bound real estate player to a high-growth stock** post-COVID, riding on favourable housing demand, policy tailwinds, and sector re-rating.

5. Yes Bank

- ✓ **2016–2018:** Strong uptrend from ~₹180 to peak near ₹400. Indicates robust growth and positive investor sentiment during expansion phase.
- ✓ **2019–2020:** Sharp collapse to below ₹20. Reflects severe financial distress, rising NPAs, and eventual regulatory intervention (RBI-led bailout in 2020).
- ✓ **2021–2024:** Flat and stagnant trend in the ₹10–₹20 range. Minimal recovery, indicating lost investor confidence and ongoing structural challenges.
- ✓ **Overview:** Yes Bank's price trajectory reflects a classic case of **rapid growth followed by a financial meltdown**. Despite stabilization efforts, its prolonged underperformance and low valuation suggest persistent market caution.

Rubric Question 3: Stock Returns Calculation and Analysis

Log Returns of Stocks

- **Log returns** (or logarithmic returns) measure the percentage change in an asset's price using natural logarithms. They are commonly used in financial analysis and modelling due to their mathematical properties. They have the following advantages: -
 - ✓ **Time Additivity:** Log returns over multiple periods can be added.
 - ✓ **Normality Assumption:** More likely to be normally distributed — useful in risk models.
 - ✓ **Comparability:** Better for comparing across different assets or time scales.
 - ✓ **Symmetry:** Handles large drops more naturally than simple returns.
- Below is the subset (top 10 rows) of the dataset post computing log returns of stocks: -

	ITC Limited	Bharti Airtel	Tata Motors	DLF Limited	Yes Bank
0	NaN	NaN	NaN	NaN	NaN
1	0.004598	-0.045315	0.000000	0.059592	-0.011628
2	-0.013857	0.019673	-0.031582	-0.008299	0.000000
3	0.036534	0.038221	0.087011	0.016529	0.005831
4	-0.041196	-0.003130	0.024214	0.000000	0.017291
5	0.009302	0.024769	-0.024214	0.055791	0.082238
6	-0.013986	-0.006135	-0.019803	-0.015625	-0.037538
7	-0.004706	-0.015504	-0.015114	-0.040166	0.042787
8	0.094452	-0.025318	-0.012772	0.016261	0.030930
9	0.012793	0.019048	0.040308	0.039531	0.039806

Figure 10: Log Returns of Stocks

Mean & Standard Deviation of Stock Returns

- Calculating the **Mean of Log Returns** for all Stocks: -

Yes Bank	-0.004737
ITC Limited	0.001634
Tata Motors	0.002234
Bharti Airtel	0.003271
DLF Limited	0.004863

Figure 11: Mean of Log Returns for Stocks

- Calculating the **Standard Deviation of Log Returns** for all Stocks: -

ITC Limited	0.035904
Bharti Airtel	0.038728
DLF Limited	0.057785
Tata Motors	0.060484
Yes Bank	0.093879

Figure 12: Standard Deviation of Log Returns for Stocks

Mean vs Standard Deviation of Stock Returns

- Below is the table summarizing the **Returns & Volatility** of all 5 stocks: -

	Stock_Means_(LogReturns)	Stock_StandardDeviation_(LogReturns)
ITC Limited	0.001634	0.035904
Bharti Airtel	0.003271	0.038728
Tata Motors	0.002234	0.060484
DLF Limited	0.004863	0.057785
Yes Bank	-0.004737	0.093879

Figure 13: Returns & Volatility for all Stocks

- Plotting **Reward vs Risk (Return vs Volatility, i.e. Standard Deviation)** for all 5 stocks: -

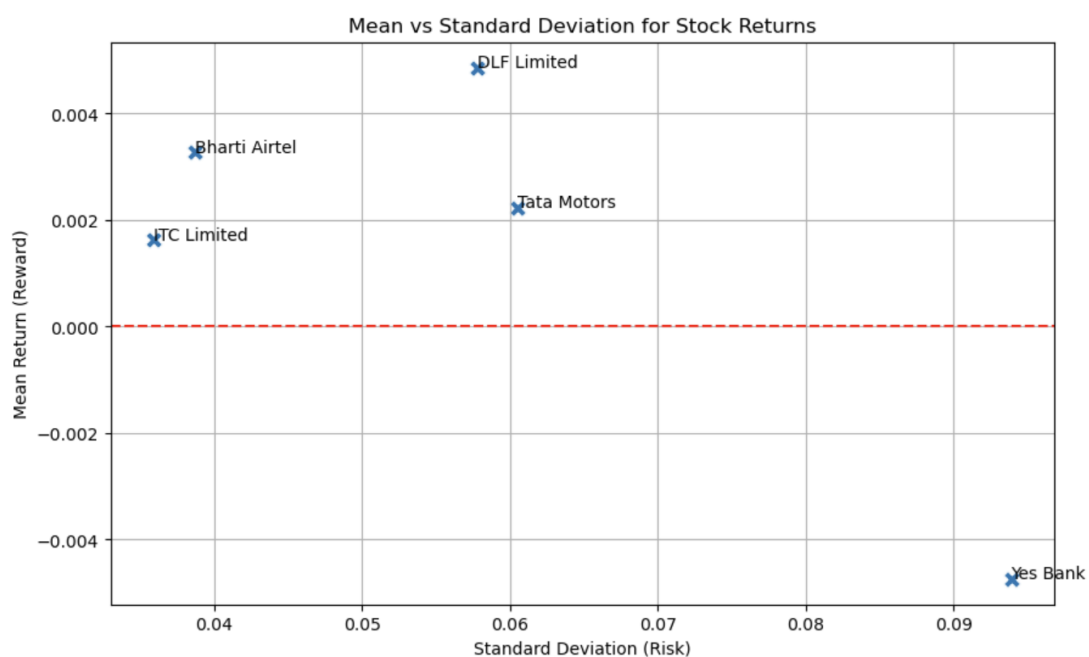


Figure 14: Scatterplot | Mean vs Standard Deviation of Stocks

Observations & Inferences

- ITC**
 - Lowest risk & stable/reliable** performance.
 - Ideal for **conservative investors** or capital preservation strategies.
- Bharti Airtel**
 - Positioned toward the **efficient frontier: good return with moderate risk**.
 - A strong candidate for **risk-adjusted returns** in a diversified portfolio.
- Tata Motors**
 - High risk but moderate return**; not the most efficient in risk-adjusted terms.
 - May appeal to **tactical or cyclical investors** betting on sector recovery.

4. **DLF Limited**

- Top-right quadrant: **High return, relatively high risk.**
- Appealing for **growth-oriented investors** willing to accept volatility for greater rewards.

5. **Yes Bank**

- Below the red zero-return line and far right: **high volatility & negative returns.**
- **Poor investment profile**; indicates historical losses with no consistent recovery.

➤ **Summary: -**

- ✓ **Risk-Reward Trade-off:** **DLF Limited** and **Bharti Airtel** strike a favourable balance between return and volatility.
- ✓ **Stable Option:** **ITC** offers the most stable return profile, suitable for low-risk portfolios.
- ✓ **Aggressive Cyclical Bet:** **Tata Motors** is a cyclical and sentiment-sensitive stock which could be included selectively in a diversified portfolio if paired with relatively more stable stocks.
- ✓ **High-Risk Outlier:** **Yes Bank** stands out for all the wrong reasons—highest risk, worst returns. It should be avoided or treated as a speculative bet only.
- ✓ **Diversification Benefit:** Combining low-risk (**ITC**) with high-return (**DLF/Airtel**) stocks can enhance overall portfolio performance.

Rubric Question 4: Actionable Insights & Recommendations

Actionable Insights

1. **ITC: Safe and Steady**
 - Lowest risk (0.0359) with consistent but modest returns (0.00163).
 - Defensive in nature, with strong cash flows from FMCG and tobacco businesses.
 - Outperformed recently, indicating a re-rating from markets.
 - **Insight:** Use as a **risk stabilizer** in volatile portfolios. Ideal for **capital preservation and dividend-focused strategies**.
2. **Bharti Airtel: Balanced Performer**
 - Provides a solid risk-adjusted return with low volatility (0.0387) and decent return (0.00327).
 - Well-positioned in the telecom market with rising ARPU, 5G rollouts, and industry consolidation.
 - **Insight:** Suitable as a **core holding** in both balanced and growth portfolios. Leverage its stability and digital expansion strategy.
3. **Tata Motors: High Volatility, Moderate Return**
 - Volatility (0.0605) is relatively high, while return (0.00223) is moderate.
 - EV ambitions, JLR recovery, and cyclical tailwinds support long-term potential.
 - Not ideal on pure risk-return basis but may be valuable in thematic plays.
 - **Insight:** Allocate cautiously. Ideal for **thematic auto/EV bets**. **Pair with low-risk assets** for diversification.
4. **DLF Limited: Strong Growth, High Volatility**
 - Delivers the highest mean log return (0.004863), indicating robust growth potential.
 - Volatility is moderate (0.0577), which is acceptable given the return.
 - Ideal for growth-focused investors or real estate believers.
 - Likely benefitting from urban housing demand, interest rate cycles, and policy tailwinds.
 - **Insight:** Allocate **higher weight in aggressive/growth portfolios**; monitor real estate sector indicators closely.
5. **Yes Bank: High Risk, Negative Return**
 - Worst performer: Negative mean return (−0.0047) and highest volatility (0.0938).
 - Reflects unresolved structural issues and poor investor confidence.
 - Price has remained flat despite restructuring and regulatory support.
 - **Insight:** **Avoid** for long-term investing. May be treated as a **speculative or turnaround bet only if high risk is acceptable**.

Business Recommendations

1. **Portfolio Construction Strategy:**
 - **Core-Satellite Approach:**
 - ✓ **Core:** Stable performers like **ITC & Bharti Airtel**
 - ✓ **Satellite:** Growth picks like **DLF Limited** and speculative (small) exposure to **Tata Motors**
 - **Avoid exposure** to **Yes Bank** in portfolios targeting stability and positive returns.
2. **Sector-Based Allocation:**
 - **Increase weight** in telecom and real estate sectors (**Bharti Airtel, DLF Limited**).
 - **Exercise caution** in financial sector exposure due to cases like **Yes Bank**.
 - Auto sector (**Tata Motors**) should be part of **cyclical allocations, not core**.
3. **Risk Management Recommendations:**
 - Maintain exposure to **low-volatility stocks (like ITC)** to **offset portfolio-level risk** from high-beta stocks (like **Tata Motors** or **DLF Limited**).

4. **Tactical and Thematic Opportunities:**

- Watch for **policy shifts** and **sectoral tailwinds** (e.g., rate cuts for real estate, EV incentives).
- **DLF Limited** and **Tata Motors** can be included as **tactical bets during strong economic cycles**.

5. **Review and Rebalancing**

- Perform **quarterly reviews** of risk-return positions.
- **Replace underperformers (like Yes Bank)** with emerging consistent performers.
- **Rebalance sector weights** based on macroeconomic developments.