

Technical Report: CAPM & Regression Analysis Tool

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1 Approach

The objective was to develop a Python-based analytical tool to evaluate the risk and performance characteristics of Indian stocks using the **Capital Asset Pricing Model (CAPM)**. The design philosophy focused on:

- **Automation:** Developing a fully automated pipeline using Python to fetch real-time data from Yahoo Finance, eliminating the need for manual data handling.
- **Robustness:** Implementing "defensive coding" techniques to handle inconsistent data formats (e.g., missing 'Adj Close' columns) without crashing.
- **Visual Communication:** Utilizing `seaborn` and `matplotlib` to transform raw statistical outputs into interpretable visual insights (Regression Lines and Heatmaps).

2 Methodology

2.1 Data Acquisition & Cleaning

Data was sourced using the `yfinance` library. A critical challenge encountered was the inconsistency in column naming (some updates return 'Adj Close' while others return 'Close').

- **Solution:** I implemented a **Conditional Selection Logic**. The script checks for 'Adj Close' first, falls back to 'Close', and finally uses an `iloc[:, 0]` "brute force" method to ensure data is always captured regardless of formatting changes.
- **Timeframe:** A 2-year window (2023–2025) was selected to analyze recent market trends.

2.2 Mathematical Framework (CAPM)

The core analysis relies on the Single Index Model regression:

$$R_{stock} = \alpha + \beta(R_{market}) + \epsilon$$

- **Data Transformation:** Raw prices were converted to **Daily Returns** using the percentage change formula: $\frac{P_t - P_{t-1}}{P_{t-1}}$.
- **Regression Model:** I utilized **Ordinary Least Squares (OLS)** via the `statsmodels` library.

3 Results and Key Insights

Aggressive Risk Profile (Beta Analysis)

The regression analysis yielded a **Beta of 1.2325**. This indicates that the target stock is approximately **23% more volatile** than the benchmark (Nifty 50).

- **Interpretation:** The stock is "Aggressive." It amplifies market movements rather than acting as a defensive hedge. For every 1% rise in the market, the stock is statistically expected to rise by 1.23%.

Performance Evaluation (Alpha Analysis)

The calculated **Daily Alpha was -0.00055**.

- **Insight:** The negative sign indicates underperformance relative to the risk taken.
- **Annualized Impact:** While the daily figure appears small, it annualizes to a significant drag on returns ($\approx -13.8\%$), suggesting that despite the high volatility ($\text{Beta} > 1$), the stock failed to generate adequate excess returns over the analyzed period.

Goodness of Fit (R-Squared)

The model returned an **R-Squared value of 0.5403**.

- **Meaning:** Market movements explain roughly **54%** of the stock's daily variance. The remaining 46% is driven by idiosyncratic (company-specific) factors, indicating that while the market is a major driver, the stock retains significant independence.

4 Conclusion

The tool successfully automates the calculation of Beta and Alpha, providing an instant risk profile. For the analyzed period, the data characterizes the target asset as a **High Risk / Negative Reward** investment, as evidenced by a $\text{Beta} > 1$ coupled with a negative Alpha. The tool's ability to isolate these metrics allows for data-driven portfolio allocation decisions.