

PROJECT-10

Multivariate time series forecasting

Project Description: This project focuses on performing a multivariate time series forecasting on stock market data for Microsoft, Google, Netflix, and Apple. Using Python and various analytical techniques, the study explores stock volatility, correlation, risk-return trade-offs, time-series patterns, and future stock price predictions to derive actionable financial insights.

Libraries Used: The analysis is conducted using the following Python libraries:

- **NumPy:** For numerical operations and handling arrays.
- **Pandas:** For data manipulation and analysis.
- **Matplotlib & Seaborn:** For data visualization.
- **Statsmodels:** For statistical modelling and time series analysis.
- **Scikit-learn:** For machine learning and preprocessing tasks.

Data Exploration and Summary: The initial phase involves importing the dataset and conducting exploratory data analysis (EDA):

- **Summary statistics for stock prices and returns** to understand distribution, central tendencies, and dispersion.

Exploratory Data Visualization: Several visualizations are created to gain insights into the stock data:

- **Line Plots of Stock Prices Over Time:** Visualizes the historical trends of stock prices.
- **Histograms of Daily Returns:** Illustrates the return distribution for each stock.
- **Box Plots of Stock Volatility:** Highlights stock price fluctuations and risk levels.
- **Heatmap of Correlations:** Displays the correlation matrix between the selected stocks to assess relationships.

Volatility and Risk-Return Analysis: The study evaluates the financial risk associated with the selected stocks:

- **Rolling Volatility Calculation:** Uses moving averages to analyse fluctuations over different time frames.
- **Sharpe Ratio Computation:** Assesses risk-adjusted returns for each stock to determine their performance relative to risk.

- **Daily Risk vs. Return Scatter Plot:** Compares risk (volatility) and return across all four stocks to evaluate investment potential.

Time Series Analysis and Forecasting: The project examines trends, stationarity, and predictive modelling for stock prices:

- **Closing Price Trend Analysis:** Visualizes stock price trends for each company.
- **Stationarity Check using Augmented Dickey-Fuller (ADF) Test:** Determines whether the stock prices are stationary.
- **Differencing Technique:** Applies differencing to make non-stationary time series data stationary.
- **Vector Autoregression (VAR) Model:** Trains a VAR model to forecast future stock prices.
- **Forecast Visualization:** Displays historical closing prices along with forecasted prices for each stock.

Comparative Analysis: The final stage involves drawing comparative insights between the selected stocks:

- **Performance Comparison:** Evaluates the overall profitability and risk of each stock.
- **Market Behavior Patterns:** Derives insights into sector-wide trends and macroeconomic influences.

Conclusion: The project provides key insights into stock market behavior, volatility, risk-return trade-offs, and future price movements. It aids in understanding investment opportunities, risk mitigation strategies, and comparative financial performance among major technology stocks. The analysis can be extended further for portfolio optimization and predictive modelling for long-term investment planning.