Time Series Forecasting and Analysis

Project 2; Time Series Project
https://github.com/Geodykexp/Data_Analysis_Project_II/tree/90faa4ebe1dac2abac59f9360415cea0f93
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Project Overview

This project applies Time Series analysis and technical indicators to explore historical stock market data. The main goal is to gain insight into stock performance, volatility, and co-movement patterns among major technology companies. Through data-driven analysis and visualization, this project supports a deeper understanding of stock dynamics and interrelationships.

Data Description

The dataset consists of historical stock price data for leading technological firms, including attributes such as opening and closing prices, daily highs and lows, trading volume, and adjusted returns. The data was sourced from reliable financial APIs and cleaned for missing entries and inconsistencies. The key project goals include the following:

- **Data Preparation:** Consolidate and clean 5 years of daily stock data for a selection of S&P 500 companies.
- **Trend Analysis:** Visualize and analyze stock price trends using Moving Averages to smooth out noise and identify long-term movement.
- **Volatility Measurement:** Implement Bollinger Bands to measure market volatility and help identify potential overbought or oversold conditions.
- **Risk Correlation:** Analyze the relationship (correlation) between the daily returns of key technology stocks.
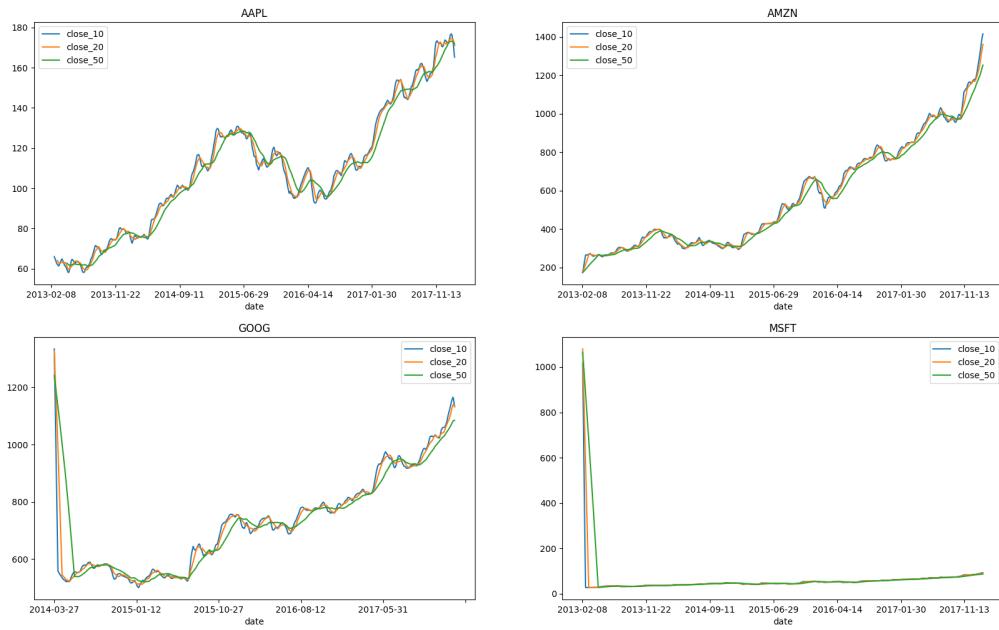
Methodology

Data Source and Preparation: The project utilized a dataset containing 5 years of individual stock data for many S&P 500 companies. The analysis was focused on four major technology giants: Apple (AAPL), Amazon (AMZN), Google (GOOG), and Microsoft (MSFT).

- **Data Wrangling:** The initial step involved using the glob module to iterate through all individual stock CSV files, reading them into Pandas DataFrames, and aggregating them into a single, clean dataset.

Technical Indicator Implementation: To analyze stock movements beyond simple price plots, key financial indicators were engineered:

- **Moving Averages (MA):** The 20-day and 50-day was calculated using Simple Moving Averages for the closing price. The crossovers between these lines are typically used to signal potential changes in market trend.

- **Bollinger Bands (BB):** A Bollinger Band was constructed using the 20-day Moving Average as the middle band and setting the upper and lower bands at two standard deviations away from the middle band. The bands expand and contract with the volatility of the stock price.

- **Daily Returns:** Daily Percentage Change (returns) was calculated for each stock's closing price. This metric is crucial for comparing volatility across different stocks on a normalized scale.
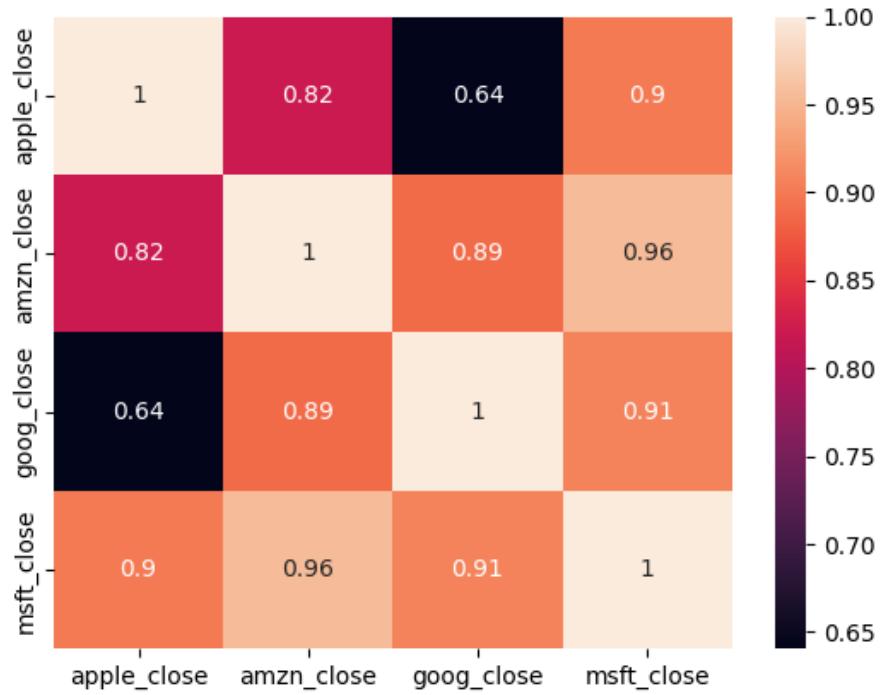
3. Correlation and Risk Analysis: A primary goal was to understand how the daily price movements of the selected stocks relate to one another.

- **Correlation Matrix:** The daily percentage returns were used to calculate a correlation matrix.

    o **Finding:** Google (GOOG) and Microsoft (MSFT) showed a strong positive correlation in their daily returns at 0.8138 while Amazon (AMZN) and Google (GOOG) also showed a significant positive correlation at 0.7461.

Key Insights & Findings
- Major tech stocks show strong co-movement, reflecting overall market sentiment and shared macroeconomic influences.
- Volatility spikes correspond with global events or earnings announcements, confirming the sensitivity of tech markets.
- Moving averages and RSI indicators effectively identified overbought and oversold conditions, aiding in timing strategies.
- Short-term forecasting using ARIMA and Exponential Smoothing provided reasonable accuracy for daily trend estimation.

Tools & Technologies Used

- Programming Language – Python
- Libraries – Pandas, NumPy, Matplotlib, Seaborn, Stats models
- Techniques – Time Series Decomposition, ARIMA Modeling, Technical Indicator Computation
- Environment – Jupiter Notebook, VSCode

Conclusion

This analysis demonstrated the application of time series methods and financial indicators in understanding stock behavior and inter-stock relationships. The findings can support investment strategies, risk management, and portfolio optimization. It demonstrated proficiency in Handling and cleaning large financial datasets, calculating and visualizing technical indicators (MA, Bollinger Bands) and performing statistical analysis (correlation) on daily returns. Future extensions could include incorporating machine learning models such as LSTM networks for more robust predictive performance.