CS 661

Python EDA Presentation

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Introducing the Dataset

- NVIDIA is a global leader in **GPU technology, artificial intelligence, and high-performance computing**, playing a crucial role in industries like gaming, data centers, and autonomous vehicles. As a publicly traded company, its stock price has been subject to **significant volatility influenced by market trends, technological advancements, and economic shifts**. Understanding this volatility is essential for investors and analysts to assess risks and opportunities.
- This analysis explores **NVIDIA's stock performance from 2014 to 2024**, focusing on key financial metrics like **daily returns, trading volume, and volatility indicators**. By leveraging **Exploratory Data Analysis (EDA)** techniques, we aim to uncover patterns in price movements, identify high-risk periods, and evaluate the impact of market events on stock behavior.
- By analyzing stock trends and technical indicators, this study provides insights into **how NVIDIA's stock has evolved over the past decade**. Key findings from this analysis can help investors make informed decisions by understanding periods of high volatility, identifying long-term trends, and evaluating the stock's overall stability in response to market conditions.

Dataset Overview

- The dataset comprises **2,541 daily stock records from January 2014 to early 2024**, covering critical financial indicators. It includes **date, stock prices (open, high, low, close), trading volume, and daily returns**, allowing for a detailed assessment of NVIDIA's stock behavior over time.
- In addition to basic price and return metrics, the dataset features **advanced technical indicators** such as **rolling volatility, Average True Range (ATR), moving averages, and Bollinger Bands**. These indicators help evaluate market trends, identify volatility spikes, and assess potential buy/sell signals based on price fluctuations.
- With these data points, we can analyze **NVIDIA's stock volatility trends, detect high-risk periods, and uncover correlations between volume, price, and returns**. This dataset enables a comprehensive study of **how NVIDIA's stock responded to market changes and investor sentiment over the past decade**.

EDA Methodology

1. Data Loading & Setup

- Imported essential libraries: `pandas`, `numpy`, `matplotlib`, `seaborn`.
- Loaded NVIDIA stock dataset (`NVIDIA_Stock_Volatility_2014_2024.csv`).
- Configured the notebook environment (Google Colab integration).

2. Data Exploration

- Used `df.head()` to inspect initial rows.
- Checked dataset structure (`df.info()`) to confirm data types and completeness.
- Summarized statistical properties using `df.describe()`.

3. Data Cleaning

- Checked for missing values (`df.isnull().sum()`)—none found.
- Ensured date columns were in proper `datetime` format.
- Removed unnecessary columns if they did not contribute to analysis.

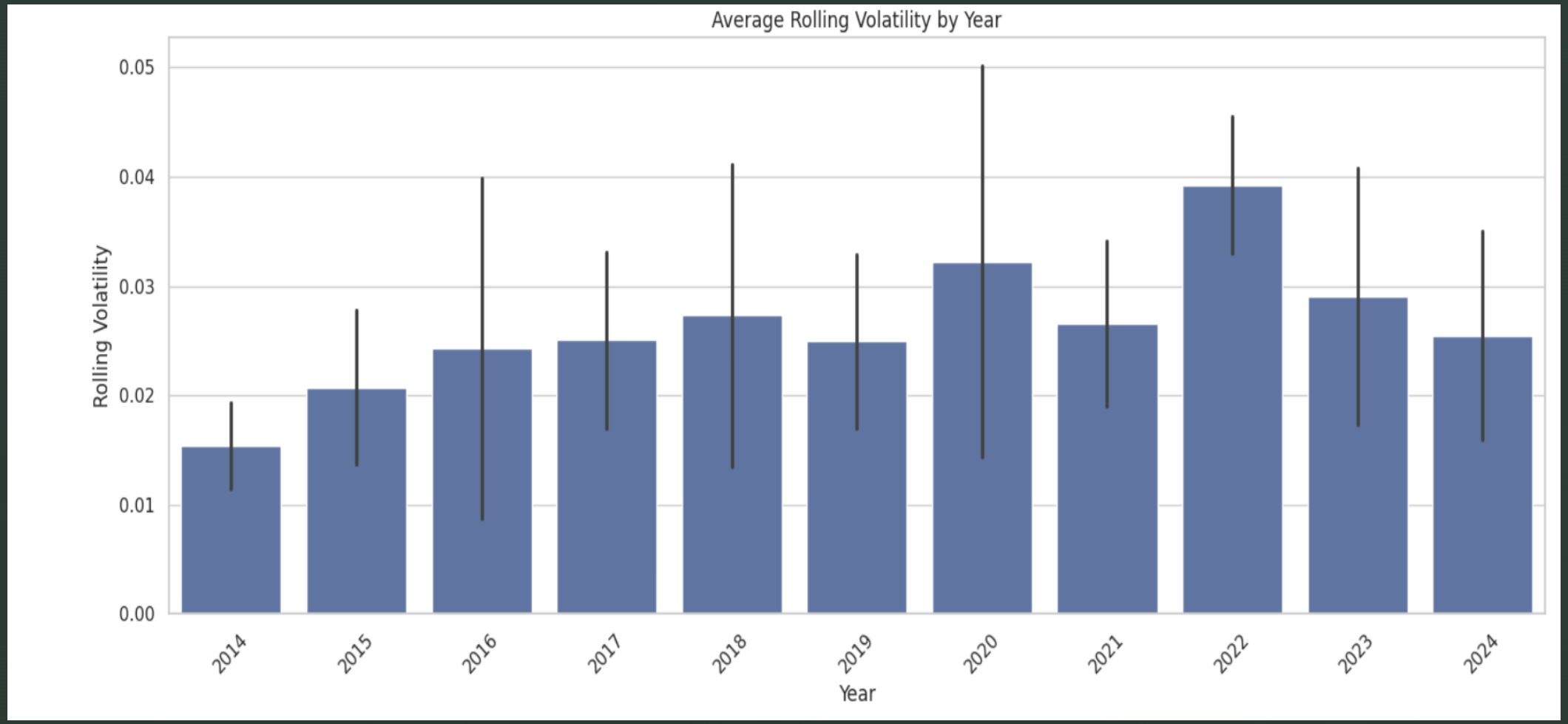
4. Data Visualization

- **Stock Price Trends:**
  - Used line plots to show NVIDIA's price movement over time.
  - Identified major price surges and dips, correlating them with market events.
- **Volatility Analysis:**
  - Calculated **rolling volatility** using moving averages.
  - Examined **Average True Range (ATR)** as a measure of stock fluctuations.

- **Bollinger Bands Analysis:**
  - Plotted upper and lower bands to observe price deviations from moving averages.
  - Identified overbought and oversold conditions.
- **Return Distribution:**
  - Used histograms & KDE plots to examine daily return distributions.
  - Identified skewness and fat-tailed distributions, indicating high-risk periods.

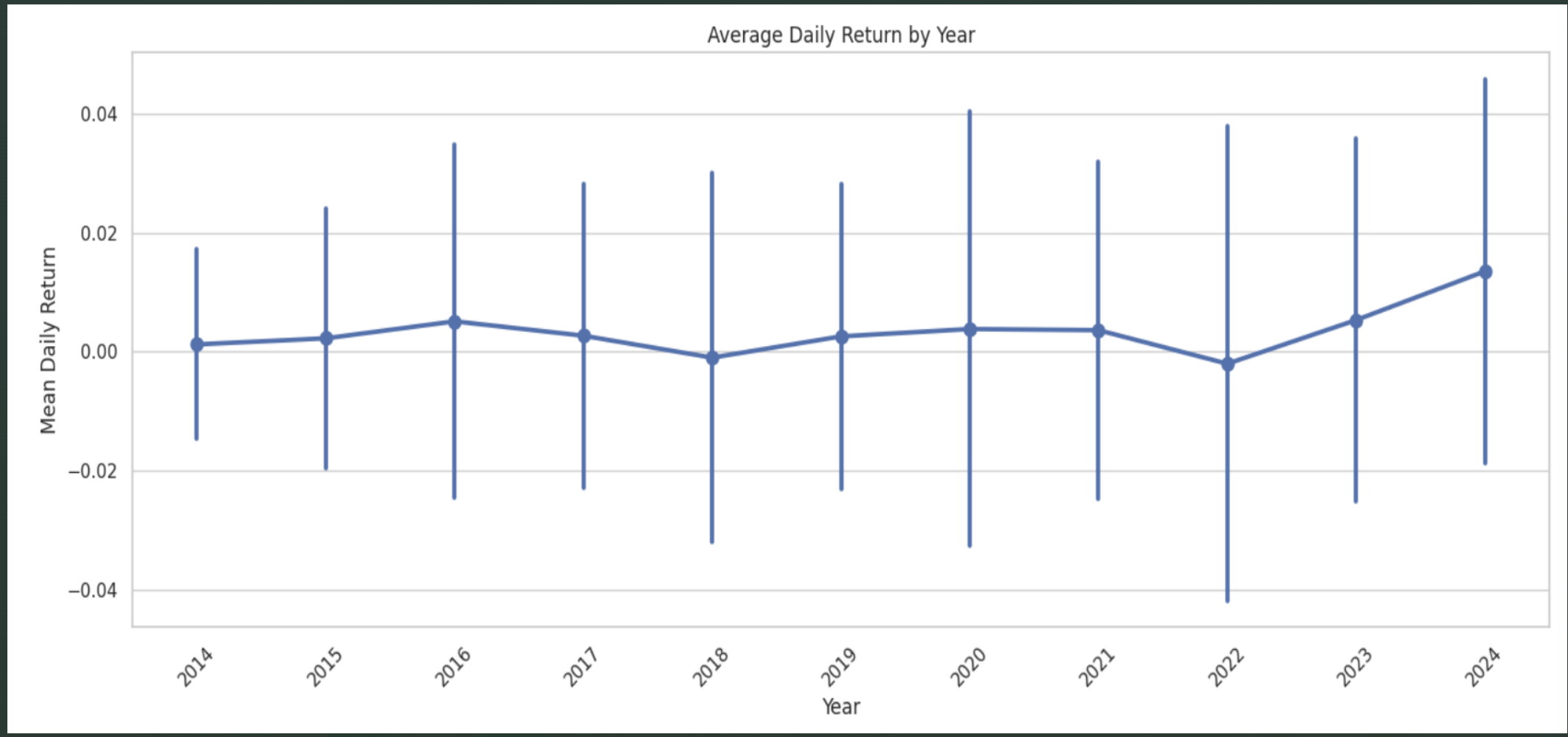
Key Insights from Analysis

- NVIDIA's stock has seen exponential growth from 2014 to 2024, with prices ranging from $0.36 to $88.68 and an average of $11.10.
- Volatility peaked at 8.7%, averaging 2.66%, with spikes aligning with major market events.
- Trading volume fluctuated significantly, reaching 3.69 billion shares in a day, averaging 460.8 million.
- Volatility correlates moderately with trading volume (0.38) and ATR (0.38), while stock price movements alone have a weaker impact (~0.18).
- This suggests that NVIDIA's volatility is driven more by investor activity and market events than by price changes alone.



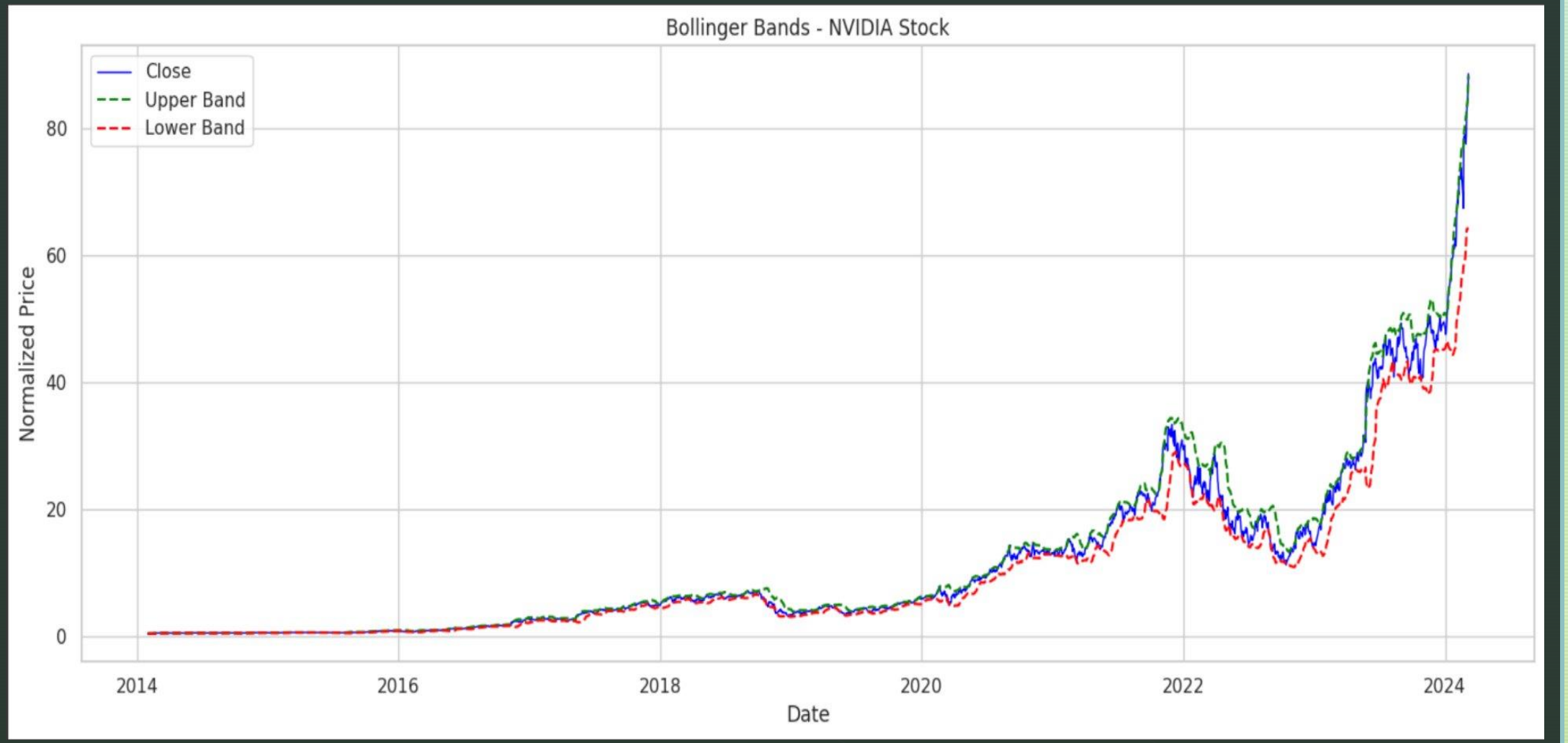
Shows how stock volatility fluctuated annually. Identifies high-volatility periods and possible reasons (e.g., market crashes, major company events).

If 2015 shows taller bars than 2014, it suggests NVIDIA's stock became more volatile. If the error bars are also larger in 2015, this indicates the volatility itself was more unpredictable that year.

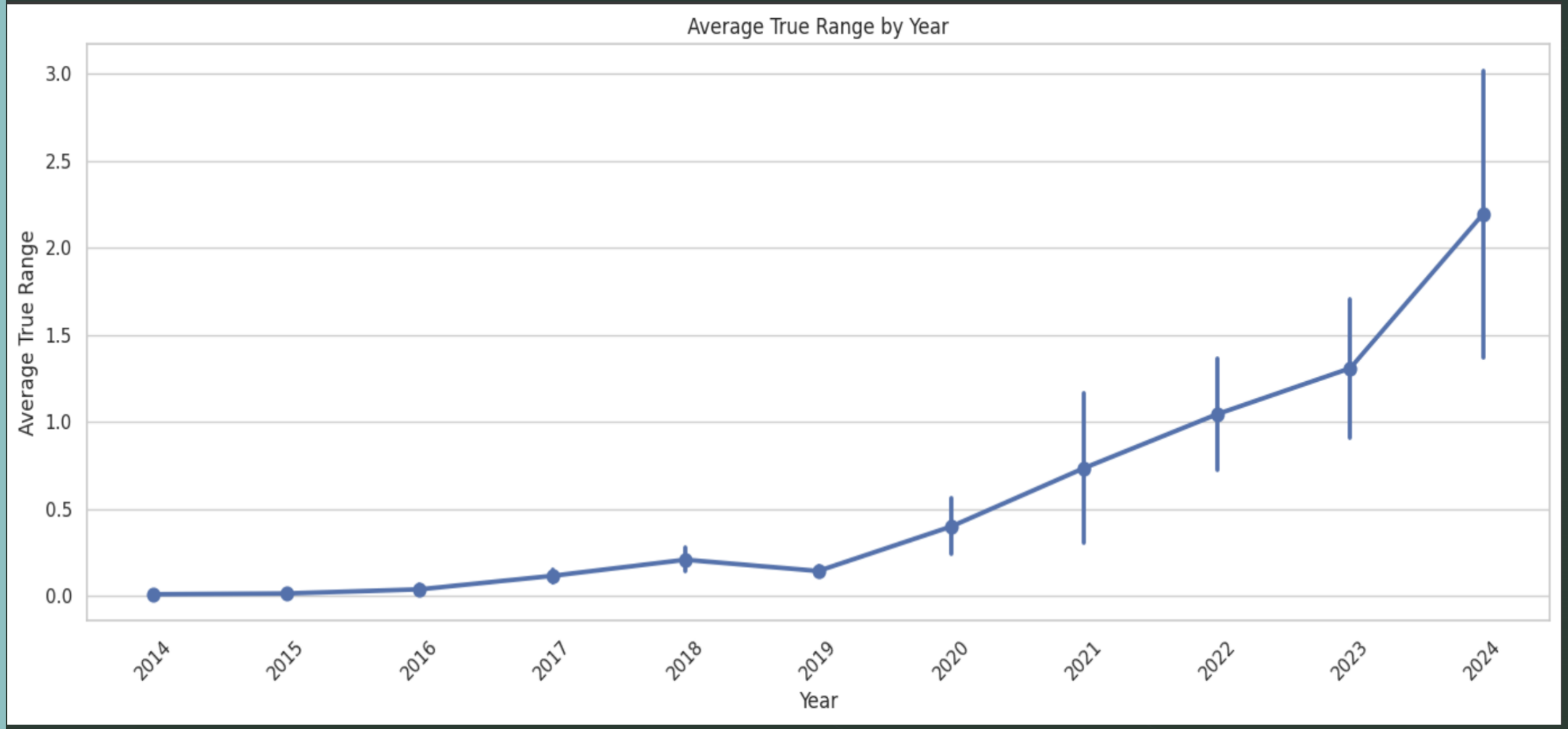


Reveals trends in stock performance over the years (Identify peak years and those with declining trends)
This chart displays the **average daily returns** of NVIDIA's stock for each year in your dataset (2014-2024), with vertical lines showing the variability around these averages.

Shows the historical trend of NVIDIA’s closing stock price over the years. Highlights major stock price movements.



The output clearly shows how NVIDIA's price interacts with these statistically significant boundaries over time, revealing periods of high and low volatility in the stock's trading history.

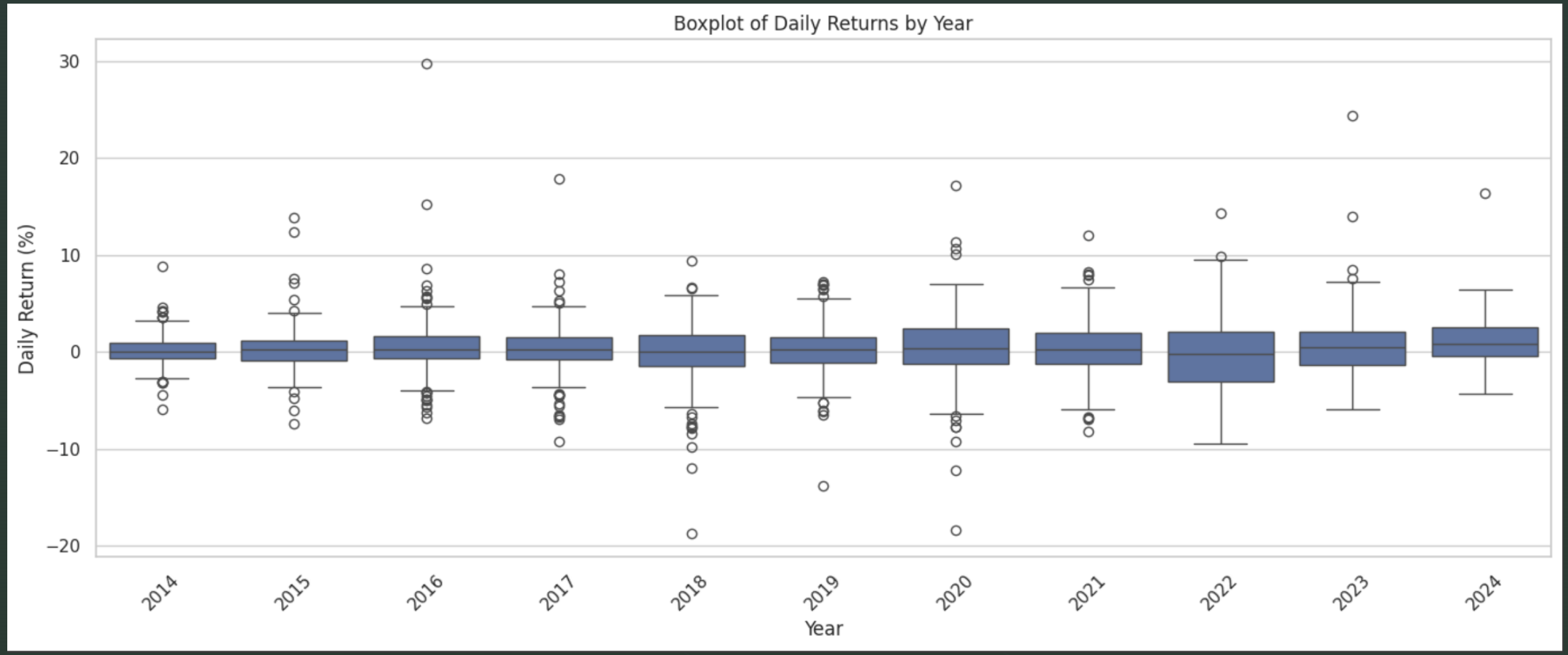


This chart displays the **average volatility** of NVIDIA's stock price each year, as measured by the **Average True Range (ATR)**, with error bars showing the variability in volatility within each year.

The output provides a clear, statistical summary of how NVIDIA's price swings evolved annually critical for risk management.

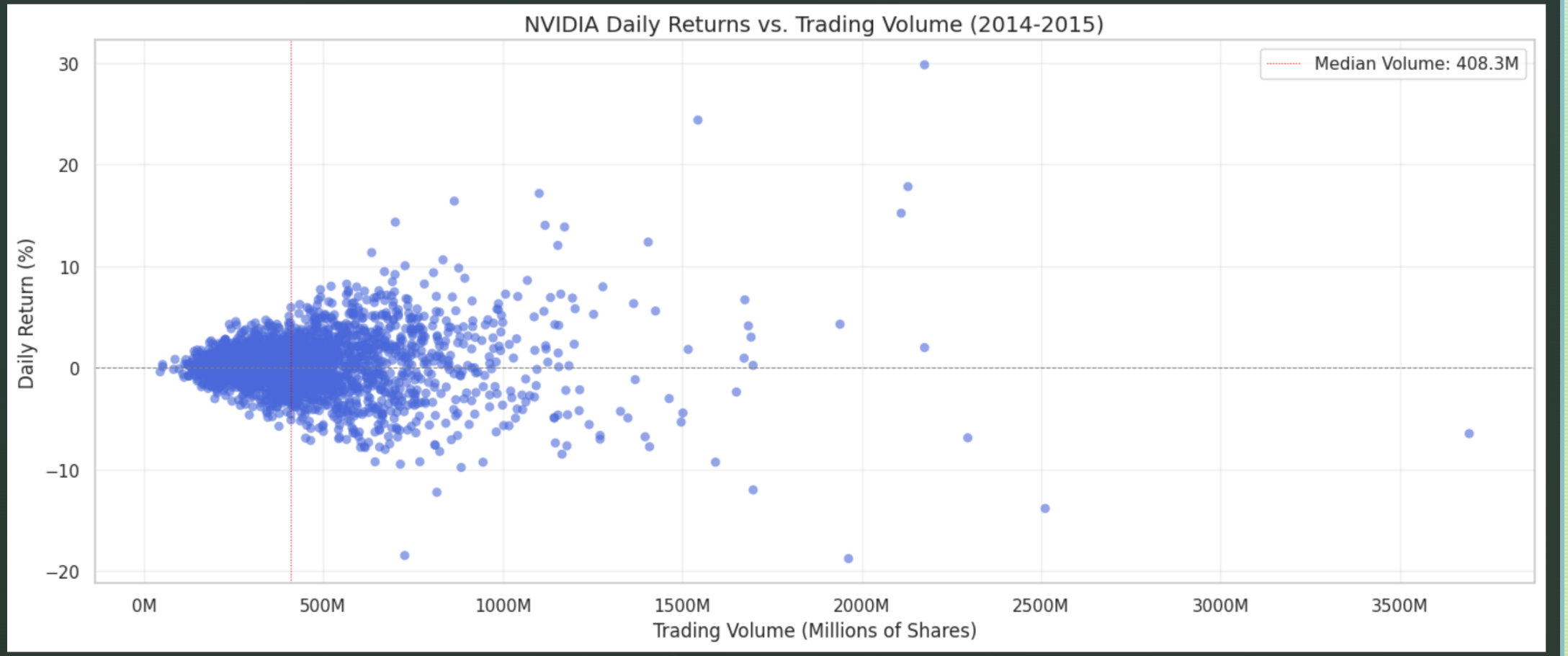
This chart displays the **total annual trading volume** of NVIDIA stock as a filled area plot, showing how trading activity changed year-over-year from 2014-2024.

The output provides a macro view of how NVIDIA's trading activity evolved - critical for understanding liquidity conditions during different market regimes.



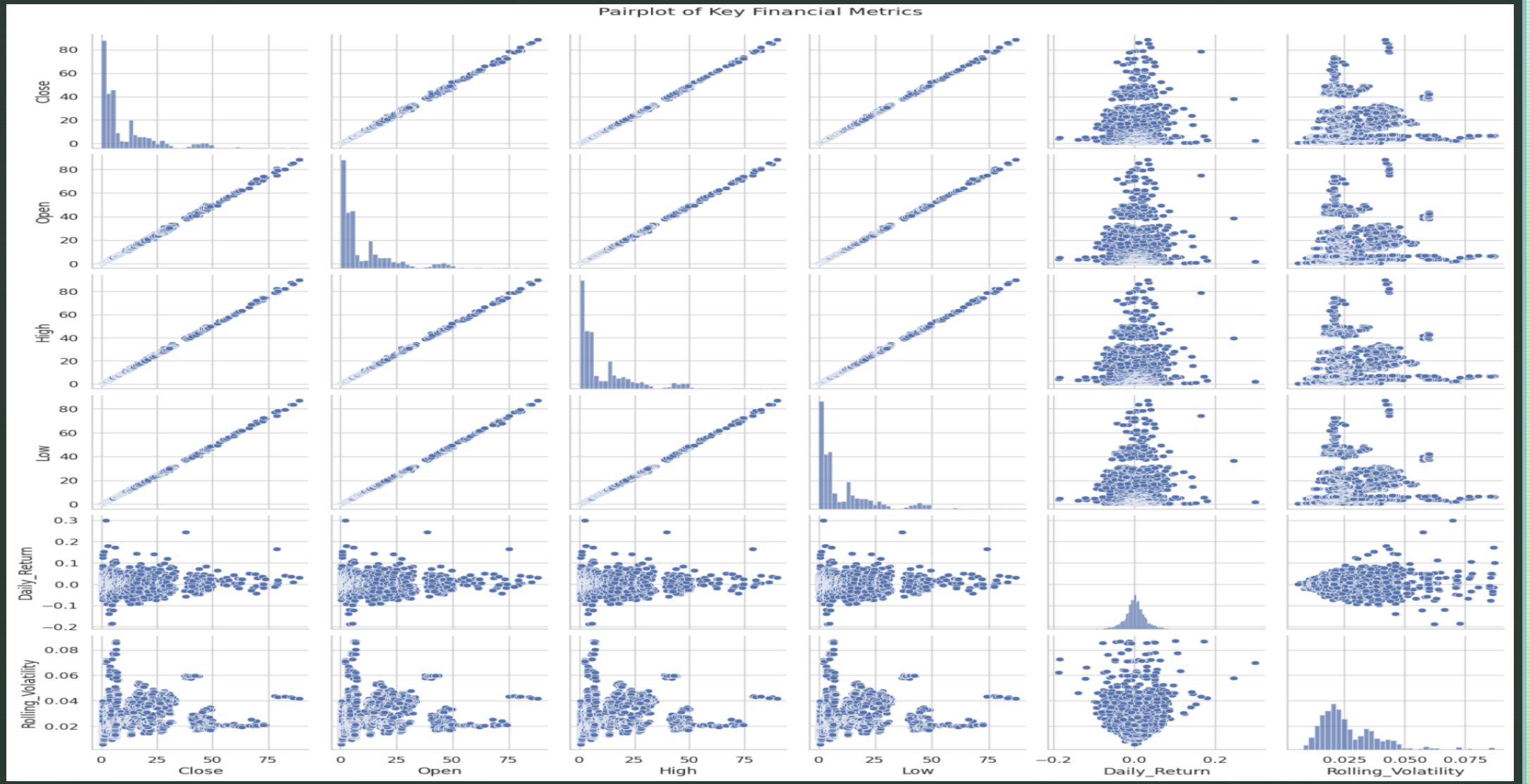
This chart displays the distribution of NVIDIA's daily percentage returns for each calendar year, using boxplot statistics to highlight key volatility and performance characteristics.

The output provides a compact yet powerful view of how NVIDIA's daily price movements evolved annually - crucial for both fundamental and technical analysis.



This chart examines the relationship between NVIDIA's daily trading volume (x-axis) and daily percentage returns (y-axis) during 2014-2024, with key reference lines for interpretation.

The output provides a foundational view of how trading activity and price movements interacted during NVIDIA's early growth phase - critical for understanding historical price discovery mechanisms.



Displays relationships between multiple financial variables like stock price, volume, and volatility.

Recommendations

- Based on the observation that NVIDIA's volatility is significantly influenced by investor activity and market events recommendations for investors include...
- •Diversifying Portfolios: Investors should spread their investments across different asset classes and industries to reduce risk and mitigate any negative impacts in one area.
- •Monitoring Technical Indicators: Use Bollinger Bands and ATR to identify any overbought/oversold conditions and potential entry/exit points.
- •Incorporate sentiment analysis: Provide a more real-time understanding of investor sentiment and its potential impact on volatility.

Further Analysis

- Volatility spikes aligning with major market events suggest a recommendation to conduct a more detailed study of these specific events and their direct impact on NVIDIA's stock. This could involve analyzing news articles and macroeconomic data around those periods.
- •Event-Driven Analysis: Investigate how specific events (e.g., product launches, geopolitical shifts) impact volatility and returns.
- •Machine Learning Integration: Predict future volatility using models like GARCH or LSTM networks.
- •Comparative Analysis: Benchmark NVIDIA’s performance against peers (e.g., AMD, Intel) to contextualize its volatility and returns.

Conclusion

Summary of Findings

- NVIDIA's stock grew exponentially during the period of 2014–2024 with notable volatility spikes tied to market events and investor activity.
- Volatility was more strongly correlated with trading volume and ATR than price movements alone.
- Distributions indicate frequent high-risk periods, highlighting the need for cautious trading strategies.

Implications

- The analysis highlights the importance of EDA in financial decision-making
- NVIDIA's resilience and growth potential make it a compelling case study for AI and tech-driven markets.

Final Takeaway

- Investors should combine technical indicators and macroeconomic trends/events to understand NVIDIA's volatility better.

References

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- W. McKinney, *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython*. O'Reilly Media, 2017.
- J. C. Hull, *Options, Futures, and Other Derivatives*, 9th ed. Boston, MA, USA: Pearson Education, 2012.

GitHub Repository:

https://github.com/yogeshpunmiya14/Python-EDA-Project