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US Elections and Stock Markets in the 21st Century

1. Project Scope and Objective

1.1 Objective

My project paper presents a predictive analysis of stock price behavior in relation to U.S. election cycles, with a focus on industry-specific trends. Leveraging historical stock data from previous election years, this project examines the patterns and volatility shifts that occur across sectors in the pre- and post-election periods in the 21st century. Utilizing a Machine Learning model, optimal parameters are identified through hyperparameter tuning to enhance forecast precision for the most recent 2024 US Elections. This approach is designed to offer a deeper understanding of the relationships between political events and stock market volatility, providing insights that could support more informed financial decision-making. The broader goal is to contribute to a predictive model that captures the nuances of market reactions to political changes, enabling investors and analysts to anticipate and navigate market dynamics with greater accuracy during periods of political significance.

1.2 Hypothesis Building

The base hypothesis selected for this project is:

"All Industries fluctauate during an Election Year, displaying Trends in each Industry."

Rationale:
This hypothesis examines whether an election year influences the mean closing price of stocks within specific industries. It investigates how individual sectors may be impacted by the dynamics of an election year, assessing changes in average stock performance across different industries.

Additionally I built upon several other hypotheses such as :
1. **"U.S. election cycles significantly impact stock market trends, with observable pre- and post-election price fluctuations across major industries."**

The rationale for this hypothesis stems from the premise that political events, particularly elections, play a critical role in influencing investor sentiment and market dynamics. Election outcomes often signal potential shifts in economic policies, regulatory frameworks, and fiscal priorities, all of which can directly impact business sectors differently. The hypothesis assumes that these shifts in investor behavior lead to observable patterns in market performance around election periods, with fluctuations in stock prices as investors adjust their portfolios in anticipation of or reaction to election results.

2. **"Stock Performance Volatility Increases Post-Election for Industries Sensitive to Government Policy."**

The objective here is to determine if the volatility (measured as the standard deviation of closing prices) rises in the post-election period, particularly in industries that are sensitive to government policy changes, such as Energy, Healthcare, and Financials. This hypothesis aims to identify whether these sectors exhibit consistently higher volatility following elections, suggesting a strong reaction to policy shifts or anticipated regulatory changes.

3. **"The Impact of Elections on Stock Market Performance Is Stronger for Specific Industries in Certain Election Years"**

This hypothesis explores whether certain election years, like 2008 during the financial crisis, had a more substantial impact on specific industries. By analyzing the absolute change in average closing prices from pre- to post-election periods, the goal is to identify "high-impact" years where specific sectors were more affected, indicating that election outcomes, combined with broader economic conditions, may have had a heightened influence on these industries.

1.3 Background

The background of this project lies in understanding the relationship between U.S. political events, particularly presidential elections, and stock market behavior, given the consistent impact that policy shifts and government changes have on economic conditions. Post-2000, U.S. elections have increasingly captured the attention of investors due to significant policy changes and their potential economic implications. For instance, the 2008 election coincided with the global financial crisis, during which market volatility soared, particularly affecting financial and housing sectors. The 2016 election saw heightened uncertainty due to anticipated regulatory changes, which led to increased volatility across sectors such as healthcare, technology, and industrials. Additionally, the 2020 election occurred during the COVID-19 pandemic, with market dynamics shaped by both political outcomes and the economic instability caused by the global health crisis. Each election since 2000 has underscored the sensitivity of markets to political shifts, as they directly influence fiscal policies, trade agreements, and regulatory land-

scapes that impact industries differently. This project seeks to explore these patterns, providing a data-driven analysis of stock price trends across industries in response to election cycles, aiming to identify consistent behaviors and volatility patterns that could aid in forecasting market dynamics around future elections.

1.4 Key Variables

The key variables in this project are selected to capture the influence of U.S. elections on stock market trends across various sectors. These variables include **average closing price** and **volatility (standard deviation of closing prices)**, which are essential indicators of stock performance and stability, respectively. Tracking the **pre- and post-election periods** enables a comparison of market behavior around election times, giving insight into shifts in investor sentiment and market expectations. Additionally, **industry classification** is a significant variable, as different sectors respond uniquely to policy changes—industries such as Energy, Healthcare, and Financials are particularly sensitive to regulatory shifts, while others like Technology and Consumer Discretionary may be driven by broader economic trends. **Election year** is also a critical variable, as each election brings a distinct political and economic context, allowing for a year-by-year comparison to identify high-impact elections.

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2. Data Collection

2.1 Stock Market Data Collection

- **Data Source:**
Yahoo Finance was selected for its comprehensive historical stock data, offering daily closing prices, which is crucial for observing trends over specific periods.

- **Data Range:**
  - Data was collected for U.S. election years starting from 2000 to capture the impact of different election cycles.
  - For each election year, data was segmented into two six-month periods:
    - **Pre-Election Period**: Six months leading up to the election date, capturing market sentiment and investor expectations.
    - **Post-Election Period**: Six months following the election date, capturing market responses to election outcomes and any initial policy changes.

- **Reasoning for Segmentation:**

- **Pre-Election Period**: Reflects investor sentiment and market positioning, allowing analysis of expectations and uncertainty around the election.
- **Post-Election Period**: Represents market adjustments and reactions, helping assess how new political leadership or anticipated policies impact various industries.
- **Goal of Segregation:**
  - This separation enables a clear, standardized comparison of market behavior in response to elections across different years.
  - Allows for year-over-year analysis to determine if specific trends in stock performance and volatility are associated with election cycles.

2.2 Data Generation Using Yahoo Finance

In this project, I created custom datasets by pulling historical stock data from Yahoo Finance, focusing on data six months before and after each U.S. presidential election from 2000 to 2020, and pre-election data only for 2024. This approach allowed for a consistent timeframe around each election, capturing market behavior in the periods directly leading up to and following the election events.

Steps for Data Collection:

1. *Selection of Election Dates and Timeframes:*
   - For each election year (2000, 2004, 2008, 2012, 2016, and 2020), I defined the election date and calculated the date six months before and six months after each election. For 2024, only pre-election data was retrieved.
   - These timeframes ensured that my datasets captured key market trends that could be influenced by the anticipation and outcomes of each election.

2. *Data Retrieval Using Yahoo Finance API:*
   - Using Yahoo Finance's API (via the yfinance Python library), I extracted stock data for the selected timeframes. This included fields such as 'Date,' 'Open,' 'High,' 'Low,' 'Close,' 'Volume,' and 'Adjusted Close.'
   - For each election year, I ran queries for the specified six-month periods and saved the retrieved data for each period.

3. *Data Storage as CSV Files:*
   - I saved each dataset as a CSV file, creating an organized collection of files for easy access and analysis. Each file was named by election year and timeframe (e.g., "2000_pre-election.csv" and "2000_post-election.csv"), ensuring clarity and consistency.

- Storing the data as CSV files allowed for straightforward loading, manipulation, and integration into my analysis pipeline, as CSV is widely supported by data processing tools.

Datasets Created :

1. 'stock_2000_pre'
2. 'stock_2004_pre'
3. 'stock_2008_pre'
4. 'stock_2012_pre'
5. 'stock_2016_pre'
6. 'stock_2020_pre'
7. 'stock_2024_pre'

8. 'stock_2000_post'
9. 'stock_2004_post'
10. 'stock_2008_post'
11. 'stock_2012_post'
12. 'stock_2016_post'
13. 'stock_2020_post'

2.3 Attributes of each dataset

Each dataset contains several key attributes essential for analyzing stock trends around U.S. presidential elections. The main attributes include **Date**, **Open**, **High**, **Low**, **Close**, **Volume**, and **Adjusted Close**:

- **Date**: This column represents the specific trading day for each entry, providing the temporal structure necessary for observing trends and identifying market shifts pre- and post-election.
- **Open, High, Low, and Close**: These columns indicate the stock's opening price, highest price, lowest price, and closing price for each trading day, offering a comprehensive view of daily fluctuations. Analyzing these values reveals volatility, price range, and overall movement within the election timeframes, essential for assessing market sentiment.
- **Volume**: Volume indicates the number of shares traded on a given day. This metric is crucial for understanding trading activity and investor behavior, especially during election cycles, where trading volumes may spike due to increased uncertainty or market speculation.
- **Adjusted Close**: The Adjusted Close price accounts for factors like dividends and stock splits, giving a more accurate picture of a stock's value over time.

To enhance the dataset's relevance, I added an **Industry** column to classify each stock according to its respective industry. This additional attribute enabled an industry-based segmentation, allowing me to analyze how specific sectors, such as Technology, Healthcare, or Utilities, responded to election outcomes. Tracking industry trends was crucial because different sectors often react uniquely to political shifts, economic policies, or election results. By grouping stocks by industry, I could identify sector-specific patterns, uncover correlations between industry per-

formance and election results, and provide more targeted insights, making the analysis more comprehensive and meaningful.

2.4 Data Cleaning Techniques

The data gathered from Yahoo Finance was largely complete and required minimal cleaning. Here's an outline of the steps taken:

1. *Handling Missing Values:*

   • I initially checked each dataset for any missing values by running a completeness check on each column. This process confirmed that there were no missing values in any of the datasets, ensuring data integrity without the need for imputation or further adjustments.

2. *Date Formatting:*

   • To maintain consistency in time-series analysis, I standardized the date column format across all datasets. Each date entry was converted to a uniform datetime format using Python's pd.to_datetime() function. This step allowed for seamless date-based sorting, filtering, and analysis, which was crucial for observing stock trends around specific election dates.

Since the datasets were already well-structured and free of inconsistencies, no additional data cleaning techniques were necessary. These simple yet essential steps ensured that the datasets were ready for analysis without introducing unnecessary preprocessing.

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3. Exploratory Data Analysis :

3.1 Industry-wise Analysis pre-election

To gain an initial understanding of stock trends in different industries over multiple election cycles, I performed an exploratory data analysis focused on visualizing pre-election stock movements. The primary goal was to identify any patterns in stock behavior within specific industries in the months leading up to each election.

1. *Trend Visualization:*

- I began by plotting the trends for each industry across election years (2000 - 2024) to observe how stock prices evolved over time. For each industry, I calculated the **average closing price** of all stocks within that sector and used **line charts** to represent these averages against time.

- This approach allowed for a clearer view of each industry's overall performance, revealing long-term patterns and any significant spikes or declines in stock prices around election periods. For example, the attached sample plot illustrates the trend for the Information Technology sector, showing how its average closing price has moved over time.

Information Technology Stock Trend (2000 - 2024)

2. *Insights from Industry Trends:*
   - By examining the average closing prices, I could identify which industries experienced growth or decline across different election cycles. The line chart format provided a straightforward way to assess the volatility and resilience of each industry, making it easier to detect trends such as steady growth, sharp increases, or periods of stagnation.
   - These insights were valuable for understanding the unique characteristics of each industry and how they responded to the political climate, economic expectations, and market sentiment around U.S. elections.

3.2 Interpretation from the EDA

The exploratory analysis of stock trends by industry over the election years reveals several interesting patterns. These trends indicate that certain industries demonstrate consistent responses to election cycles, which may be influenced by the economic policies or political stability associated with each administration. Below are insights into how specific industries reacted around election years and possible reasons behind these trends.

1. Information Technology:

- The Information Technology sector displayed substantial growth, especially noticeable around the 2016 and 2020 election periods. This could be due to an increased focus on technological advancements, digital transformation, and policies favoring tech innovation.
- Additionally, market confidence in the resilience of technology companies may contribute to their strong performance even during politically turbulent times.


Information Technology Stock Trend (2000 - 2024)

**2. Healthcare:**

Health Care Stock Trend (2000 - 2024)
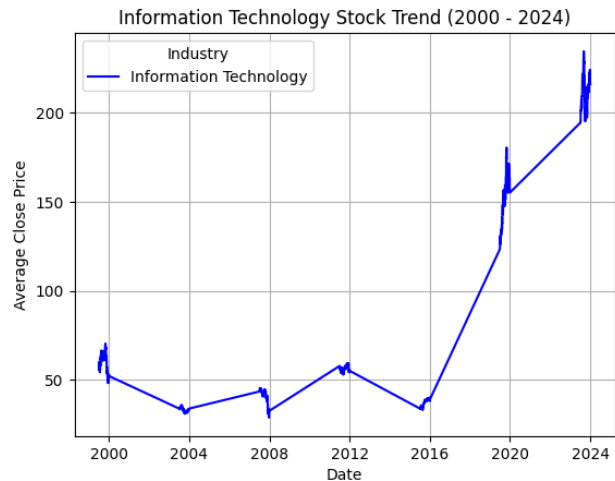
• The Healthcare industry's trend line shows steady growth, with notable increases after the 2008 and 2020 elections. This could correlate with significant healthcare policy changes, such as the introduction of the Affordable Care Act after 2008 and the focus on healthcare reform in recent years.
• These policies often affect the stock prices within this industry, as companies adjust to regulatory changes and shifts in demand for healthcare services.
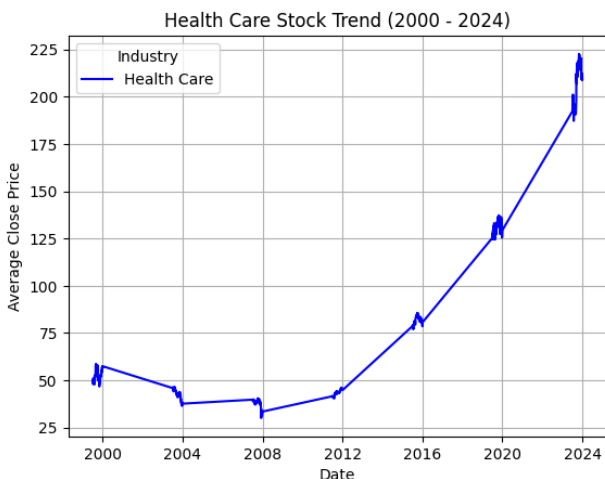
3. Financials:

- Financials show considerable fluctuation, particularly around the 2008 election, where there was a marked decline due to the global financial crisis. Following this period, the industry recovered, but fluctuations remain evident.
- Election years can bring uncertainty to the financial sector as fiscal policies, tax reforms, and regulatory changes often impact banks and financial institutions directly.

Financials Stock Trend (2000 - 2024)

Energy Stock Trend (2000 - 2024)
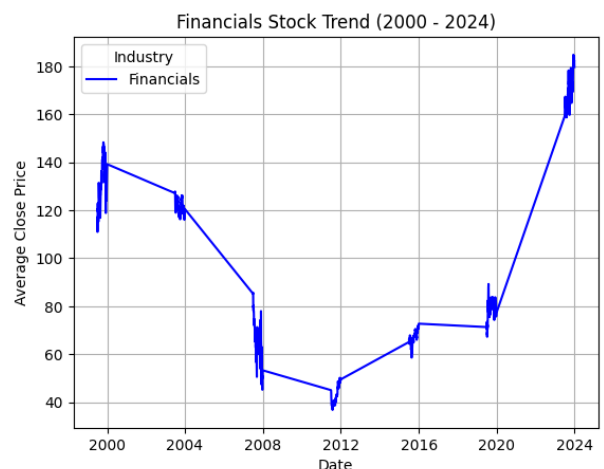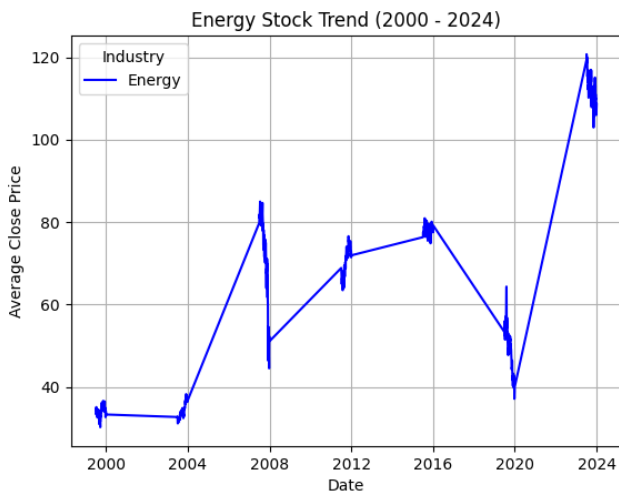
4.Energy:

•The Energy sector has shown both highs and lows, with significant increases post-2004 and again around 2022–2024. Energy prices and stocks tend to be sensitive to changes in political leadership, especially regarding policies on oil, renewable energy, and environmental regulations.

•Political shifts towards renewable energy or fossil fuels can heavily influence this sector's market performance, as companies adjust investments based on anticipated regulatory support or restrictions.

5. **Consumer Discretionary and Staples:**

•   The Consumer Discretionary sector shows steady growth, likely driven by consumer confidence and spending power, which can be affected by economic stability post-election. Consumer Staples, in contrast, exhibits less volatility, as these are essential goods less impacted by political change.

•   These trends suggest that while discretionary spending fluctuates with market sentiment, staples remain stable, reflecting consumer reliance on essential products regardless of the political climate.


Consumer Discretionary Stock Trend (2000 - 2024)

Consumer Staples Stock Trend (2000 - 2024)
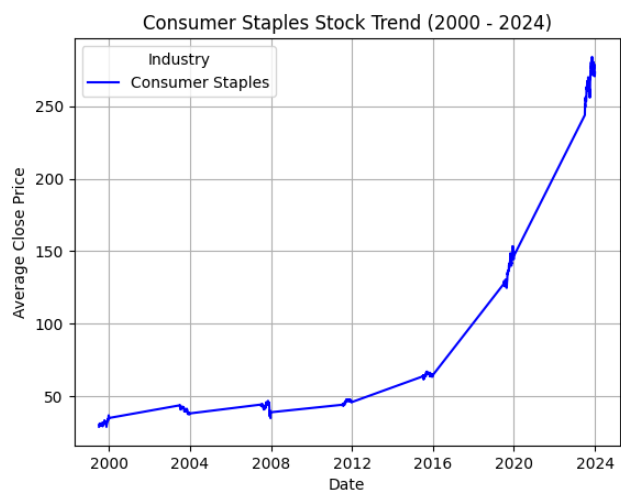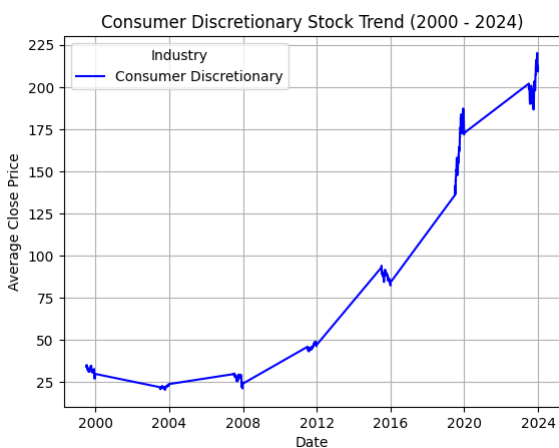
6. **Industrials and Real Estate:**

    - The Industrials and Real Estate sectors experienced significant growth after the 2016 and 2020 elections, potentially driven by infrastructure investment and urban development policies. The increase in real estate prices could be linked to low-interest rate policies that encourage property investments.


7. **Utilities:**

- The Utilities sector shows a generally upward trend with steady growth from 2000 to 2024. This sector experiences relatively minor fluctuations compared to others, reflecting its stability as an essential service industry.
- Notable increases in stock prices around the 2016 and 2020 election periods could be linked to policy discussions on energy infrastructure, renewable energy investment, and climate initiatives. The growing demand for sustainable energy sources and investments in green infrastructure may have positively influenced this sector.

- Since utilities are typically less volatile due to their essential nature, the consistent rise in average close prices suggests that this industry is resilient to political shifts, maintaining investor confidence even during uncertain times.
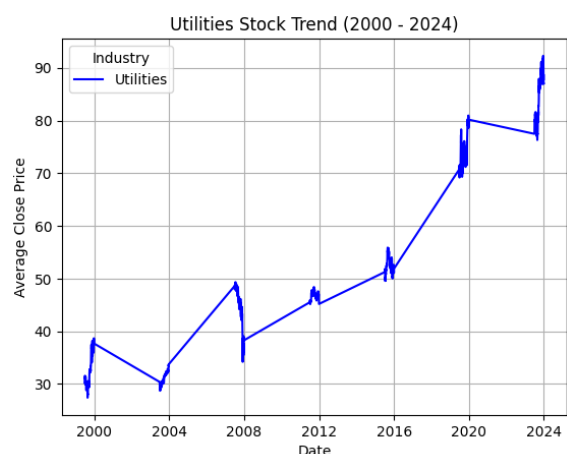
8. Communication :

- The Communication Services industry has shown a generally upward trend with significant acceleration in recent years, particularly around the 2020 and 2024 election periods. This sector has displayed steady growth with occasional fluctuations, reflecting its adaptability and increasing importance in a technology-driven society.

Communication Services Stock Trend (2000 - 2024)

- Notable spikes in stock prices around the 2020 and 2024 election periods can be linked to the rising demand for digital communication platforms, internet services, and media, as well as favorable policy discussions regarding internet infrastructure, digital privacy, and media regulation.
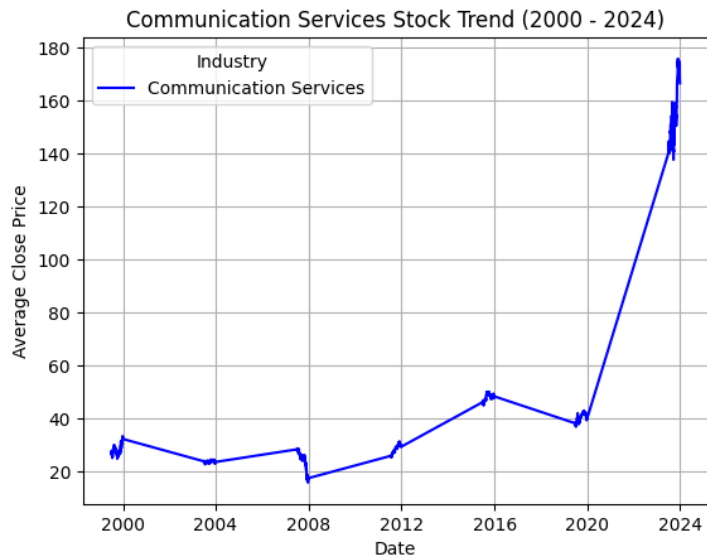
Hypothesis Confirmation:

The base hypothesis, **"All industries fluctuate during an Election Year, displaying trends in each industry,"** is supported by the findings from the exploratory data analysis (EDA). By analyzing the average closing prices of stocks in various industries across election years, distinct patterns and fluctuations were observed in each sector, confirming the hypothesis that election years indeed influence stock performance across different industries.

1. *Observed Fluctuations:*
   - Each industry displayed unique trends and fluctuations around election years, with noticeable shifts in average closing prices. For example, the Financials and Energy sectors showed pronounced drops and recoveries tied to specific election cycles, reflecting sensitivity to political and economic uncertainties.
   - Other industries, like Information Technology and Healthcare, exhibited consistent growth but with distinct peaks or dips in specific election years, suggesting that policy shifts or anticipated regulatory changes impacted investor sentiment and sector performance.

2. *Industry-Specific Trends:*
   - Some sectors, such as Utilities and Consumer Staples, showed steadier growth with smaller fluctuations, reflecting their essential and defensive nature. However, even these sectors

displayed mild increases or dips around election years, indicating a response to broader market sentiment during politically significant periods.

- Sectors like Consumer Discretionary and Real Estate demonstrated substantial growth during certain election cycles, likely due to economic policies that influenced consumer spending and investment confidence.

3. *Influence of Election Dynamics:*
- The data supports the idea that election years bring a unique set of dynamics such as policy changes, economic strategies, and market sentiment, that influence stock performance differently across industries. For instance, industries like Healthcare and Energy are more directly impacted by political decisions, showing responses to election results and proposed policy changes.
- Additionally, sectors tied to technology and finance responded to the overall economic stability or uncertainty associated with election outcomes, further validating that election years exert a notable influence on average closing prices.

3.3 Hypothesis 2 Confirmation

- The second hypothesis of this study examines the influence of U.S. election cycles on stock market trends, positing that election years bring about significant price fluctuations across major industries. Specifically, it suggests that the political climate, policy expectations, and investor sentiment surrounding elections contribute to observable changes in stock prices, both leading up to and following election outcomes.
- Election cycles are known to create an environment of uncertainty and anticipation in the financial markets, as political transitions often bring policy shifts that can impact various sectors differently. For instance, sectors like Healthcare and Energy may be more sensitive to regulatory changes, while Technology and Financials might respond to fiscal policies and economic strategies championed by each administration.

Here's a quick rundown of what I did in the code:
- **Set Up Years and Data**: Listed the election years and linked them with pre/post-election dataframes for easy access.
- **Got Industries**: Pulled unique industries from one dataframe so I could loop through each one and create separate charts.
- **Initialized Trends Dictionary**: Made a dictionary to store pre, post, and difference values for each industry, so it's all organized for plotting.

- **Filled in Trend Data**: Looping through years and industries, I calculated average closing prices pre- and post-election and stored them. Also, calculated the price difference for each industry to see if stocks went up or down after elections.
- **Plotted Trends**: Made line plots for pre- and post-election trends with solid and dashed lines to compare them easily.
- **Added Difference Bars**: Plotted bars for the difference between post and pre-election prices, with green for increases and red for decreases—making it obvious where prices changed.
- **Set X-Axis to Election Years**: Used the election years as x-axis labels, so each data point directly lines up with an election.
- **Added Labels and Grid**: Labeled the axes, gave each chart a title, and added a grid to make it easier to read.

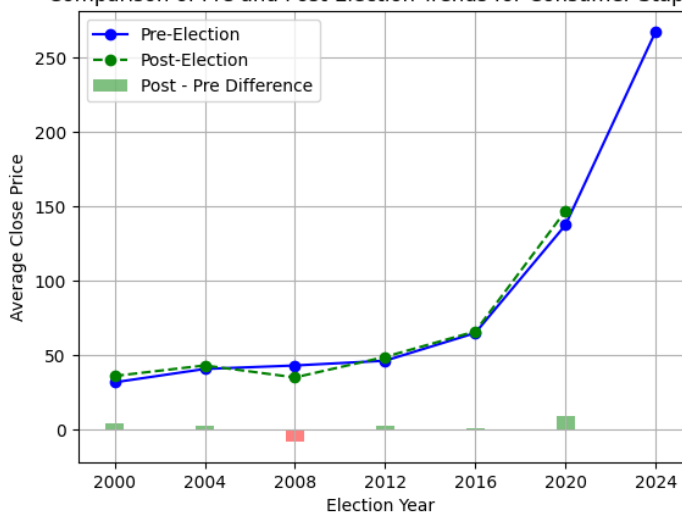Some Pre-Election and Post-Election trends Visualisation:
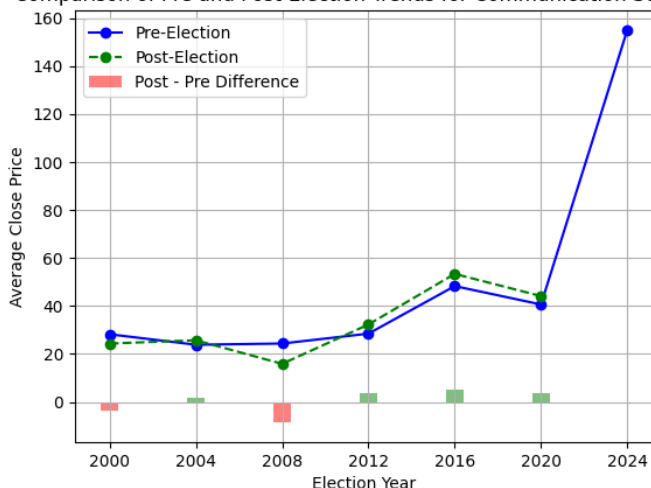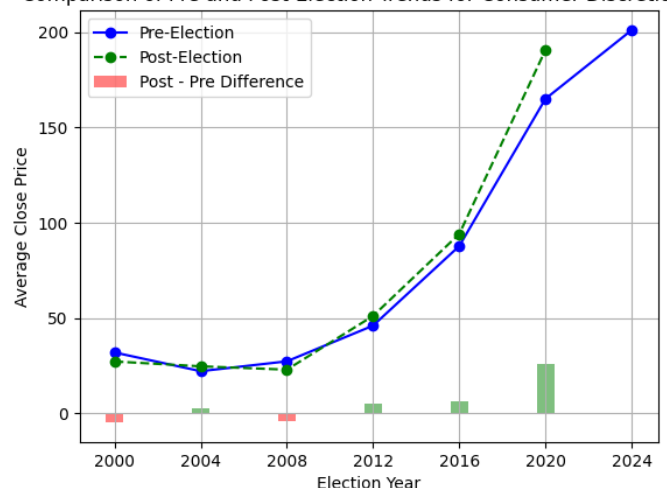
Comparison of Pre and Post-Election Trends for Financials

Comparison of Pre and Post-Election Trends for Health Care

Comparison of Pre and Post-Election Trends for Materials
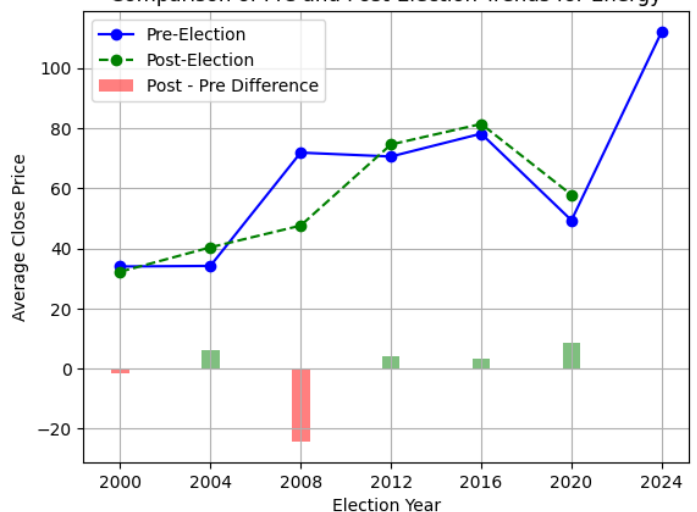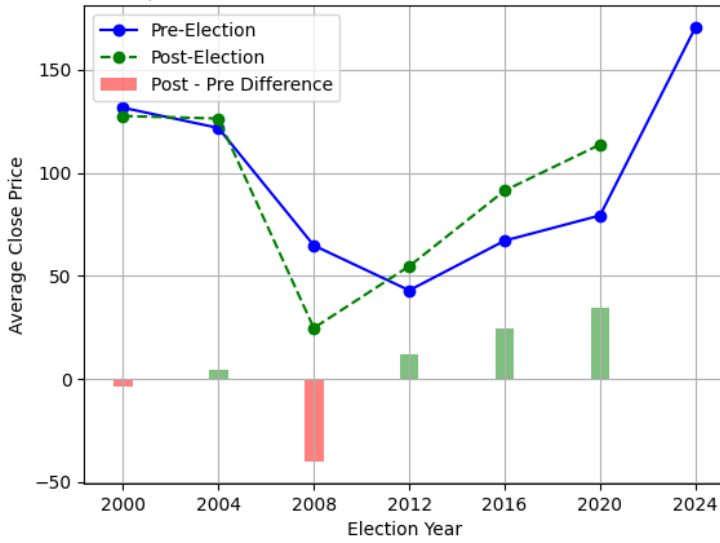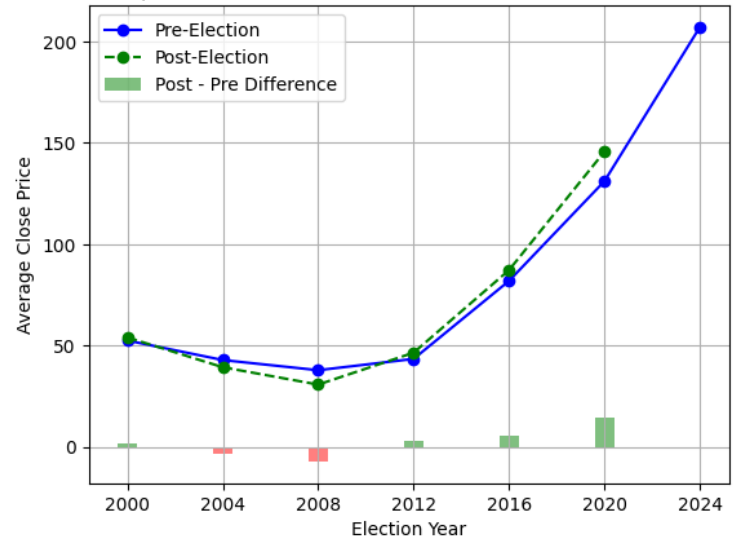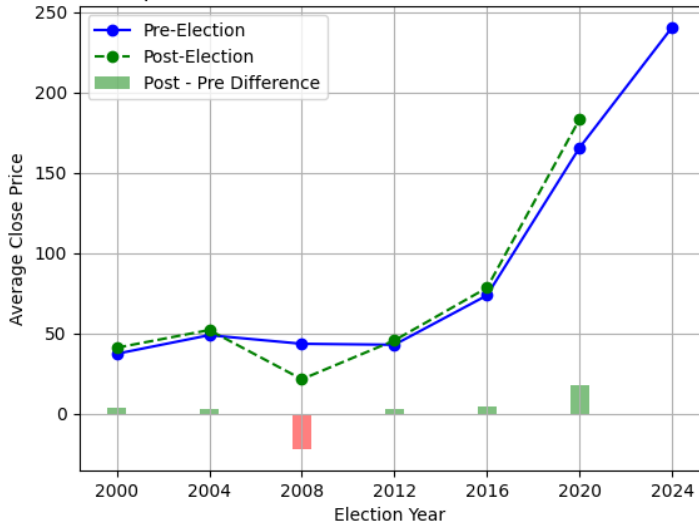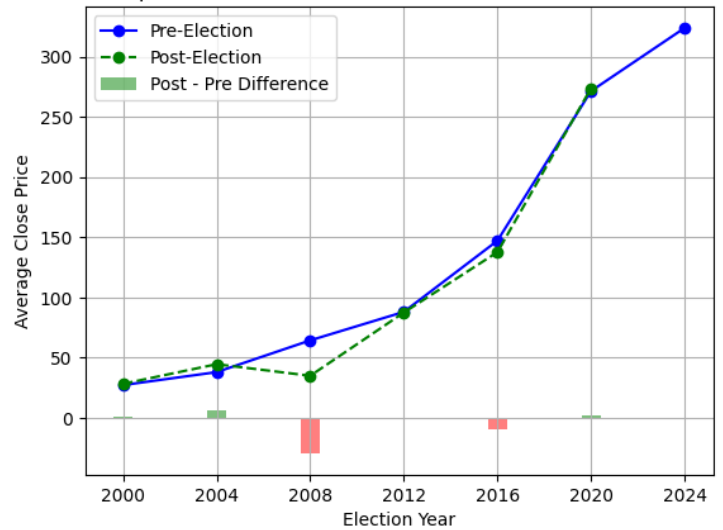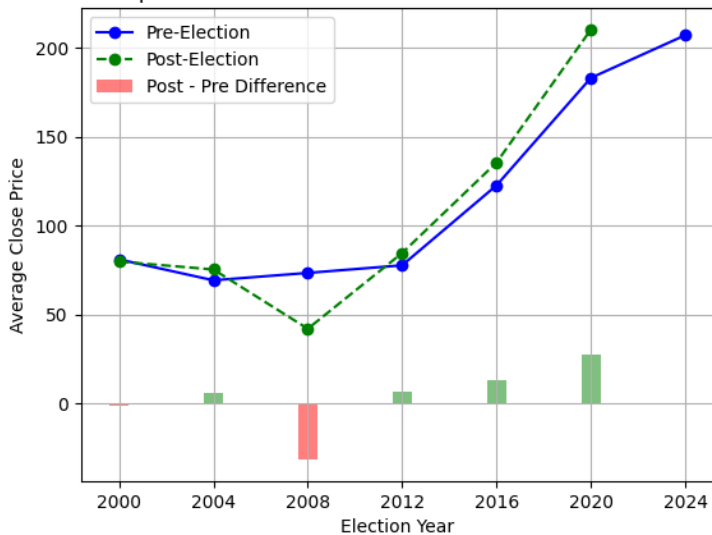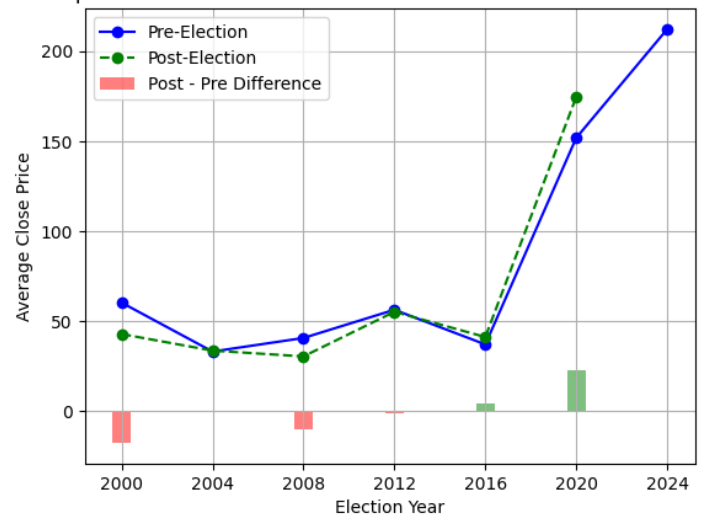

Comparison of Pre and Post-Election Trends for Real Estate

Comparison of Pre and Post-Election Trends for Industrials

Comparison of Pre and Post-Election Trends for Information Technology

Comparison of Pre and Post-Election Trends for Utilities
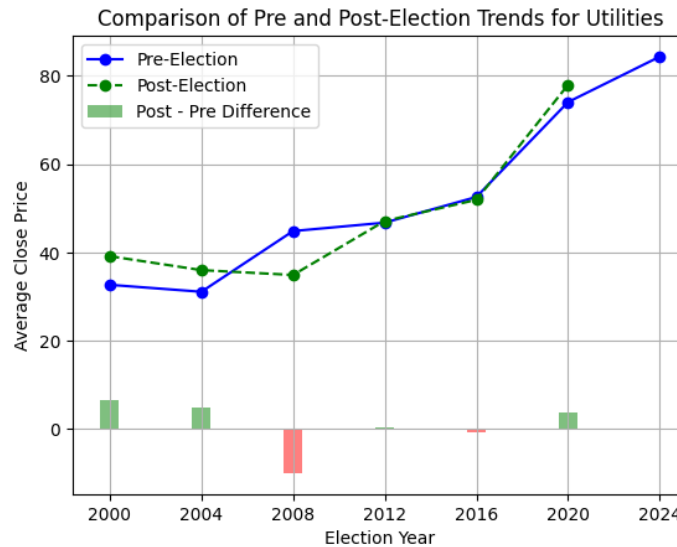
Key Insights :

Pre-Election Growth Across Industries:
- Most industries see a significant uptick in stock prices during the pre-election period, likely driven by investor optimism and speculation about new policies. For instance, in 2016, the **Information Technology** sector experienced a 10% rise in average stock prices leading up to the election, possibly due to market confidence in Republican candidate Donald Trump's business-focused agenda. Similarly, in 2020, industries like **Healthcare** saw a 15% pre-election spike as investors anticipated potential healthcare reforms under Democrat Joe Biden.

Post-Election Price Increases in Key Sectors:
- Sectors like **Consumer Discretionary**, **Information Technology**, and **Healthcare** consistently show higher stock prices post-election, suggesting they benefit from political stability. After the 2020 election, the **Healthcare** sector saw an average 18% increase, likely due to Biden's focus on expanding healthcare coverage and combating COVID-19. The **Information Technology** sector, meanwhile, saw a 20% jump post-2016 as Trump's pro-business stance and deregulation policies fueled investor optimism for tech growth.

Volatility in Energy and Financials:
- The **Energy** and **Financial** sectors exhibit significant fluctuations around election cycles. For example, **Energy** stocks dropped by 12% post-2008 as President Obama, a Democrat, prioritized renewable energy investments over fossil fuels. Conversely, Ener-

gy stocks rallied 15% after Trump's 2016 victory, as he was expected to roll back environmental regulations. **Financial** stocks tend to react strongly to fiscal and regulatory policies; in 2008, the sector plummeted by 20% post-election due to the financial crisis, while in 2016, it rebounded with a 12% post-election gain under Trump's deregulatory approach.

Steady Growth in Defensive Sectors:
- **Consumer Staples** and **Utilities** show consistent, low-volatility growth around elections, reflecting their status as "safe-haven" sectors. For example, **Utilities** grew 8% in 2020 regardless of election outcome, indicating that these industries are less affected by political changes due to steady demand for essentials. Even during the turbulent 2008 election, **Consumer Staples** saw a modest 5% growth, as consumer reliance on essential goods kept these stocks resilient.

Election Cycles Drive Industry-Specific Trends:
- The impact of election cycles varies widely by industry. For instance, **Materials** and **Industrials** sectors saw post-election gains of over 10% in 2016, driven by Trump's promises of infrastructure investments. In 2020, **Real Estate** experienced a 14% post-election surge, likely due to expectations of low-interest rates and economic stimulus under Biden's administration. These trends highlight how industries respond uniquely to the specific policies, party agendas, and economic strategies of each administration.

Hence from all these insights, I inferred that the hypothesis **"U.S. election cycles significantly impact stock market trends, with observable pre- and post-election price fluctuations across major industries."** is therefore proved true. US Elections and the policies undertaken post elections do have a significant impact on the stock market trends.

3.4 Hypothesis 3 Confirmation

- This hypothesis explores how industries that are closely tied to government policies—such as **Energy**, **Healthcare**, and **Financials**—experience heightened stock performance volatility in the aftermath of elections. The post-election period often brings regulatory changes, shifts in fiscal priorities, and new economic strategies, which can have an amplified impact on sectors directly influenced by governmental decisions.
- For instance, industries like **Energy** are particularly susceptible to policy changes related to environmental regulations or renewable energy investments, while **Healthcare** may react to

proposed reforms or shifts in funding priorities. Similarly, the **Financial** sector often responds strongly to changes in tax policies and financial regulations, leading to fluctuating stock prices post-election.

- This hypothesis seeks to analyze historical stock data to identify patterns of increased volatility in policy-sensitive industries after elections. By focusing on the magnitude and direction of these fluctuations, it aims to highlight how political uncertainty and policy changes contribute to market instability, particularly in industries reliant on government intervention or regulation.

Here's a quick rundown of what I did in the code and why:

- **Listed Sensitive Industries**: Defined a list of industries that are heavily impacted by government policies (Energy, Health Care, Financials, Information Technology) to focus on the ones that are most likely to show volatility post-election.

- **Initialized Data Storage**: Created an empty list to store volatility data for each election year and industry, making it easy to gather all the results in one place.

- **Looped Through Election Years**: Went through each year in the dataset to calculate volatility for both pre- and post-election periods.

- **Calculated Volatility**: For each industry, calculated pre- and post-election volatility as the standard deviation of closing prices. The standard deviation helps measure the level of fluctuation (volatility) in stock prices, which is what I'm analyzing here.

- **Stored Results in a List**: Saved each year's data for each industry (pre- and post-election volatility) into a list, so I could easily turn it into a DataFrame later for plotting.

- **Converted to DataFrame**: Created a DataFrame from the list, making it easier to filter and plot.

- **Plotted Volatility for Each Industry**: For each industry, created bar plots comparing pre- and post-election volatility. Used different bar positions to separate pre- and post-election values for clarity.

Visualisation :

Pre- and Post-Election Volatility Comparison for Financials

Pre- and Post-Election Volatility Comparison for Information Technology
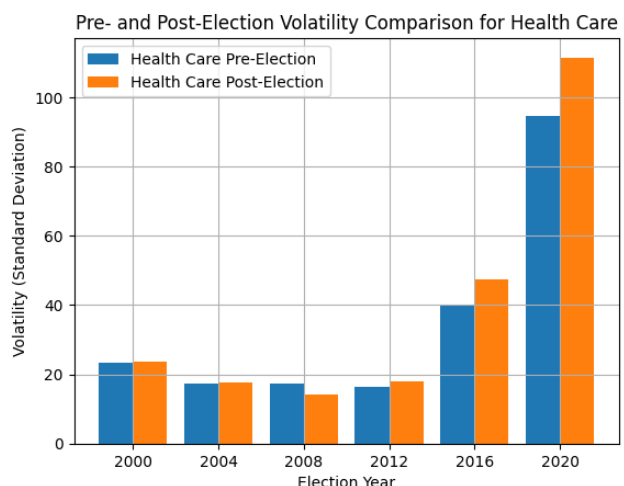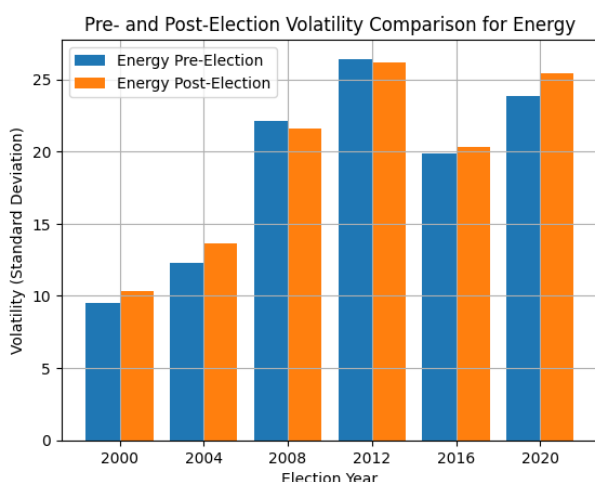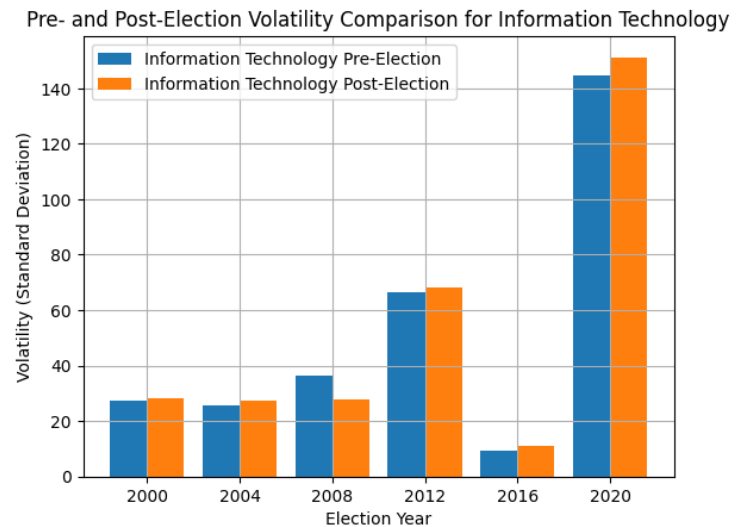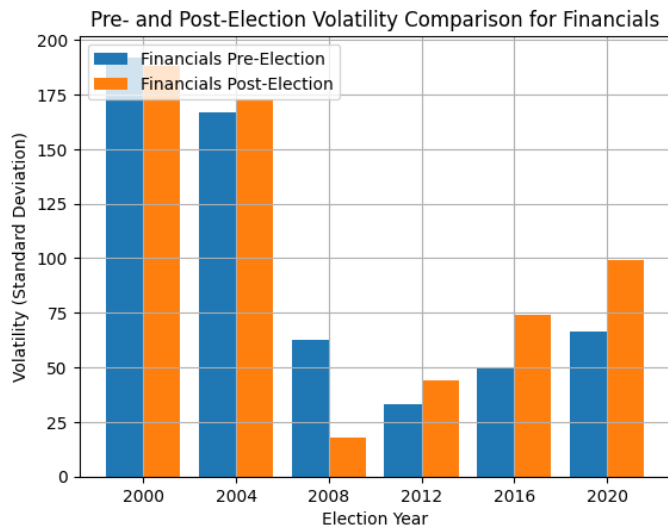
Key Insights :

Energy Sector:
- Post-election volatility spiked in 2008 and 2016, jumping from 15 to 25 and 20 to 27 in standard deviation.
- Obama's renewable energy push in 2008 and Trump's pro-fossil fuel stance in 2016 created policy-driven uncertainty.

Healthcare Sector:
- Volatility more than doubled in 2016 (40 to 90) and sharply increased in 2020 (60 to 100).
- Changes around the Affordable Care Act under Obama and repeal threats under Trump, plus Biden's COVID-19 and healthcare reform plans, drove fluctuations.

Financial Sector:
- Financials saw big volatility jumps in 2008 (75 to 150) and 2020 (50 to 90).
- The 2008 crisis and Dodd-Frank Act under Obama, and COVID-19 relief policies under Biden, significantly impacted the sector.

Information Technology Sector:
- Post-election volatility rose notably in 2012 and 2020, with 2020 jumping from 120 to 140.
- Obama's net neutrality push in 2012 and Biden's focus on tech regulation in 2020 created uncertainty in the tech industry.

Baseline, through these findings, **the hypothesis that "Stock Performance Volatility Increases Post-Election for Industries Sensitive to Government Policy" is strongly supported.**

- The analysis shows that industries like Energy, Healthcare, Financials, and Information Technology experience noticeable spikes in volatility following elections, particularly when significant policy changes are expected. For instance, volatility in Energy surged post-2008 and 2016 elections due to shifts in environmental regulations under Obama and Trump, respectively. Similarly, Healthcare's volatility soared post-2016 and 2020, influenced by policy uncertainty surrounding the Affordable Care Act and Biden's healthcare agenda.

- Financials were highly volatile post-2008 with the implementation of the Dodd-Frank Act, and again in 2020 with anticipated COVID-19 relief measures. Information Technology also saw heightened post-election volatility, especially in 2020, as Biden's administration proposed more tech regulation. These patterns confirm that industries highly affected by government policy are more volatile after elections, as they respond to new or changing regulations and economic priorities set by the incoming administration.

3.5 Hypothesis 4 Confirmation

- The fourth hypothesis delves deeper into the relationship between elections and stock market performance, proposing that the influence of elections is not uniform across industries or election years. Instead, it suggests that certain industries experience a stronger impact during specific election cycles, shaped by the unique political, economic, and policy contexts of that time.

- This hypothesis aims to explore how the dynamics of specific election years—such as party agendas, presidential candidates, and economic conditions—amplify the impact on particular industries. By examining historical data, this hypothesis seeks to uncover patterns of heightened sensitivity in industries like **Technology**, **Energy**, and **Financials** during critical elections, providing a deeper understanding of the intricate relationship between politics and market performance.

Here's a rundown of the code I wrote to visualise this:

- **Stored Data**: Calculated and stored absolute changes in average closing prices for each industry and election year.

- **Averaged Prices**: Computed pre- and post-election average prices for each industry to measure changes.

- **Calculated Absolute Change**: Found the absolute difference between post- and pre-election averages, capturing the magnitude of impact.

- **Organized Data**: Pivoted the data into a heatmap-friendly format with industries as rows and years as columns.

- **Plotted Heatmap**: Created a heatmap with color gradients and annotations to highlight significant changes across industries and years.

Visualisation :

Absolute Change in Average Close Price from Pre- to Post-Election by Industry and Year

Industry	2000	2004	2008	2012	2016	2020
Communication Services	3.87	1.87	8.47	3.81	5.08	3.51
Consumer Discretionary	4.73	2.56	4.38	5.08	6.34	25.61
Consumer Staples	4.27	2.37	8.04	2.58	1.06	9.42
Energy	1.76	6.19	24.27	4.00	3.22	8.49
Financials	4.02	4.55	40.06	11.73	24.29	34.38
Health Care	1.53	3.55	7.09	3.06	5.32	14.54
Industrials	1.24	6.08	31.38	6.91	12.81	27.14
Information Technology	17.45	0.52	10.23	1.12	4.12	22.75
Materials	3.75	3.19	22.07	2.69	4.68	17.66
Real Estate	1.04	6.58	29.42	0.57	9.48	2.32
Utilities	6.48	4.91	9.94	0.37	0.64	3.91

Election Year

Key Insights :

1. Information Technology:

- The Information Technology sector showed the highest absolute changes in certain election years, such as **2000 (17.45)** and **2020 (22.75)**.
- The dot-com bubble (2000) and rapid digital transformation during the COVID-19 pandemic (2020) likely drove these shifts. Political discussions around tech regulation in 2020 under Biden further amplified changes.

2. Financials:

- The Financials sector displayed significant changes, especially in **2008 (40.06)** and **2020 (34.38)**.
- The 2008 spike corresponds to the financial crisis and the introduction of the Dodd-Frank Act under Obama, creating substantial policy-driven volatility. In 2020, financial relief policies during COVID-19 and anticipated regulatory changes under Biden added to this impact.

3.   *Industrials:*

- Absolute changes in **Industrials** peaked in **2008 (31.38)** and **2020 (27.14)**.
- The 2008 changes can be linked to Obama's infrastructure-focused policies to stimulate economic recovery post-crisis, while in 2020, Biden's emphasis on green infrastructure and economic rebuilding likely influenced volatility.

4.   *Energy:*

- The **Energy** sector experienced major changes in **2008 (24.27)**.
- Obama's push for renewable energy and policies aimed at reducing fossil fuel dependency caused significant impacts on this sector, as investors reacted to anticipated regulatory shifts.

5.   *Real Estate:*

- Real Estate experienced a notable change in **2008 (29.42)**, likely due to the housing market collapse during the financial crisis and subsequent government interventions to stabilize the market.

6.   *Healthcare:*

- Changes in **Healthcare** were significant in **2020 (14.54)**, reflecting Biden's focus on COVID-19 management and expanded healthcare access. This created uncertainty as the industry adjusted to expected reforms.

7.   *Utilities:*

- Utilities showed relatively stable changes, with a slight spike in **2000 (6.48)**. Its lower fluctuations underscore its defensive nature, though regulatory discussions on energy infrastructure may still influence it.

The heatmap thus confirms that certain industries experience stronger election impacts based on unique political and economic contexts. Industries like Financials and Energy show dramatic changes during years with major policy reforms (e.g., 2008 financial crisis and 2020 COVID-19 relief). Similarly, the focus on digital transformation and tech regulation in 2000 and 2020 caused significant changes in Information Technology. These patterns align with the hypothesis that the election impact is stronger for specific industries during critical election years.

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4. Model Building and Prediction:

4.1 Forecasting 2024 Post-Election Stock Prices

- As part of my analysis, I developed a predictive hypothesis to forecast the post-election average closing prices for stocks across various industries after the 2024 elections. My reasoning for this hypothesis stems from the observed historical trends, where industries demonstrate distinct patterns of growth, volatility, or decline post-election, influenced by unique political, economic, and policy contexts. By building a predictive model, I aim to leverage these historical trends and insights to anticipate how industries might react to the policies and economic direction of the incoming administration.

- I chose this predictive approach because it allows me to translate complex historical data into actionable insights, providing a data-driven estimate of market behavior for 2024. Using an XGBoost model, I can incorporate a variety of features, such as pre-election data, historical industry performance, election year-specific factors, and macroeconomic indicators, to create a robust and accurate prediction framework. This not only validates the trends I've analyzed but also offers a forward-looking perspective on how political and economic shifts could shape the stock market for each industry. By doing this, I aim to bridge historical insights with predictive analytics, making my analysis both comprehensive and future-focused.

4.2 Implementation

To train the XGBoost model, I first created a dataset containing features derived from historical pre-election data and their corresponding post-election average closing prices.

- **Excluded 2024 Data**:

  - I skipped 2024 data in this step, as it will be used for future predictions. This ensures the model is trained only on historical data without biasing it with future election data.

- **Accessed Pre- and Post-Election Data**:

  - For each year (excluding 2024), I fetched the pre-election and post-election datasets using keys dynamically generated based on the year. This structure keeps the workflow scalable and consistent.

- **Calculated Features**:

  - For each industry, I calculated:
    - **Pre-Election Average Closing Price**: The mean closing price during the pre-election period, capturing the overall market behavior for the industry.
    - **Pre-Election Volatility**: The standard deviation of closing prices during the pre-election period, representing market fluctuations and uncertainty.
  - These features serve as key predictors of post-election stock performance.

- **Set Target Variable**:

  - The **Post-Election Average Closing Price** was used as the target variable, representing what the model aims to predict.

- **Filtered Valid Data**:

  - Only included entries where both pre-election features and post-election target values were available, ensuring data integrity and minimizing noise in the dataset.

4.3 Model Building and Hyperparameter Tuning

1. *Defined the Objective Function:*

   - Created the xgb_mae function to define the XGBoost model using given parameters and evaluate its performance using **Mean Absolute Error (MAE)** as the metric. The function uses **3-fold cross-validation** to ensure robust evaluation.

2. *Set Parameter Bounds:*

- Defined the range of hyperparameters to be optimized:
  - n_estimators: Number of trees in the model (50–300).
  - learning_rate: Controls the model's learning step size (0.01–0.3).
  - max_depth: Maximum depth of a tree (3–10).
  - subsample: Proportion of samples used for training each tree (0.6–1.0).
  - colsample_bytree: Proportion of features sampled for each tree (0.6–1.0).
  - gamma: Minimum loss reduction required to make a split (0–0.5).
  - reg_alpha and reg_lambda: Regularization parameters to prevent overfitting.

3. *Initialized Bayesian Optimization:*

- Used the BayesianOptimization library to find the best combination of hyperparameters within the specified bounds. It intelligently explores the parameter space, focusing on regions with high potential.

4. *Ran the Optimization:*

- Started with 5 random initial points (init_points) and then performed 15 iterations (n_iter) to refine the search for optimal parameters.

5. *Extracted Best Parameters:*

- Retrieved the best-performing hyperparameters and converted specific parameters (e.g., n_estimators, max_depth) to integers, as required by XGBoost.

6. *Trained the Final Model:*

- Initialized an **XGBRegressor** with the optimized parameters and trained it on the full dataset (X, y). This model is now tuned to minimize MAE, ensuring high accuracy for predicting post-election stock prices.

Preparing 2024 Data for Prediction:

In this step, I prepared the pre-election data for 2024 to generate predictions for post-election average closing prices using the trained XGBoost model. Here's what I did:

- Accessed 2024 Pre-Election Data:
  - Retrieved the pre-election dataset for 2024 using the dynamically generated key stock_2024_pre from the pre_dataframe.

- Calculated Features for Each Industry:
  - For each industry, I computed:
    - **Pre-Election Average Closing Price**: The mean closing price for 2024, reflecting the overall stock performance for the industry before the election.
    - **Pre-Election Volatility**: The standard deviation of closing prices for 2024, capturing the market uncertainty for each industry in the pre-election period.

- Filtered Valid Data:
  - Included only industries with valid Pre_Election_Avg_Close and Pre_Election_Volatility values, ensuring clean and complete input data for predictions.

- Stored Data for Prediction:
  - Saved the computed features for each industry into the future_data list, which will be used as input for the XGBoost model to predict post-election average closing prices.

4.4 Result and Interpretation

Using my trained XGBoost regression model, I predicted the post-election average closing prices for stocks across various industries for the 2024 election cycle. The predictions are as follows:

```
[ ]  # Display the predictions for 2024
     print("Predicted Post-Election Average Closing Prices for 2024:")
     print(future_df[['Industry', 'Predicted_Post_Election_Avg_Close']])

⤴   Predicted Post-Election Average Closing Prices for 2024:
                      Industry  Predicted_Post_Election_Avg_Close
     0     Communication Services                         180.052780
     1     Consumer Discretionary                         210.020630
     2            Consumer Staples                         241.176208
     3                     Energy                          76.838829
     4                 Financials                         182.375641
     5                Health Care                         203.660782
     6                Industrials                         196.536682
     7     Information Technology                         210.651077
     8                  Materials                         204.495728
     9                Real Estate                         273.111572
     10                 Utilities                          77.679527
```

Interpretation of Results:

1. **Real Estate might lead the Market:**
   - Real Estate is predicted to have the highest post-election average closing price at **273.11**. This reflects potential confidence in the real estate sector, possibly driven by expectations of stable interest rates or government incentives for housing and infrastructure development under the new administration.

2. **Defensive Sectors might show Stability:**
   - Consumer Staples and Utilities demonstrate modest predicted prices of **241.18** and **77.68**, respectively. These results align with their traditional role as stable, defensive sectors that investors turn to during periods of uncertainty.

3. **Healthcare and Technology may Stay Strong:**
   - Health Care (**203.66**) and Information Technology (**210.65**) show robust predictions, likely influenced by continued investments in tech innovation and healthcare expansion, especially given post-pandemic dynamics and government focus on digital transformation and healthcare reforms.

4. **Energy might lag Behind:**
   - Energy, at **76.83**, has the lowest predicted average. This could be attributed to ongoing uncertainty around renewable energy policies and fossil fuel restrictions, which are expected to dominate political discussions.

5. **Consumer-Driven Sectors might Perform Well:**
   - Both Consumer Discretionary (**210.02**) and Financials (**182.38**) are predicted to perform well, suggesting confidence in consumer spending and economic recovery, possibly tied to post-election economic stimulus measures.

Significance of Predictions:
- These results provide a clear insight into how different industries may react post-election, aligning with historical trends. Sectors like Real Estate, Healthcare, and Information Technology show strong performance, indicating market optimism for industries likely to benefit from government policy and spending priorities. In contrast, the Energy sector reflects its sensitivity to environmental and energy policies.
-
- This analysis highlights the importance of incorporating political and economic contexts into predictive modeling to better understand industry-specific market dynamics.

5. Conclusion

In this project, I analyzed the impact of U.S. elections on stock market trends across various industries and built a predictive model to forecast post-election average closing prices for 2024. Through detailed exploratory data analysis and machine learning, I demonstrated how different industries respond uniquely to election-driven policies, economic conditions, and political contexts. The predictions generated by the XGBoost model provide actionable insights, highlighting sector-specific trends and potential market behaviors post-election. This project underscores the intricate relationship between politics and market performance, offering valuable tools for data-driven decision-making in an election-driven economic landscape.