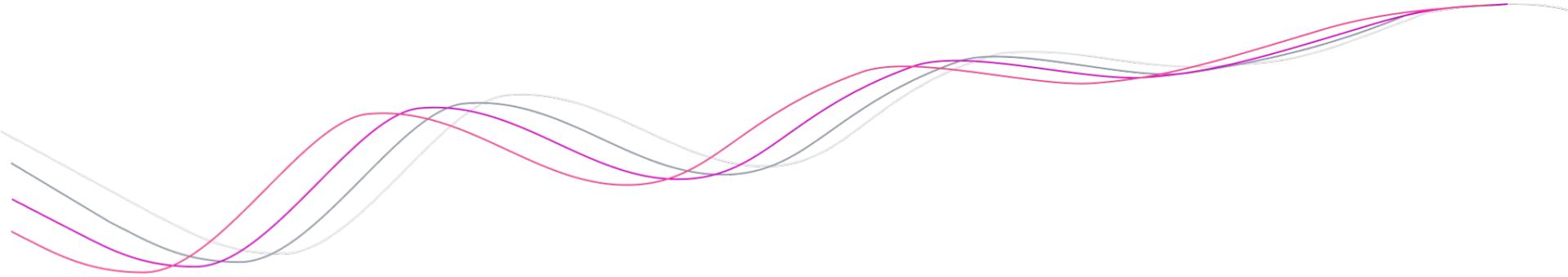


# Google Trends -> Crypto Market Dynamics

## Correlations & predictive models



Anamaria Loznianu

# Overview

1. [EDA](#)
2. [Past vs Current Trends Cycles](#)
3. [Token Price vs Trends](#)
4. [Time Lag](#)
5. [Token Patterns](#)
6. [Additional Data Sources](#)
7. [Machine Learning Model](#)

# EDA

**Target:** Conduct [exploratory data analysis \(EDA\)](#) on the dataset. What valuable insights can be derived from this analysis?

**Data Preparation Process** ([Trends](#)):

**Initial Data Structure:** The dataset comprised 20 CSV files for each cryptocurrency, presenting a fragmented structure that hindered comprehensive analysis.

**Data Integration:** To streamline the analysis process and establish a unified dataset, all individual trend CSV files were merged into a single file.

**Data cleaning:** All values <1 were replaced with 0 and additional date information were extracted from the dataset.

week	XRP	dogecoin	kucoin	fetch	ethereum	bitcoin	filecoin	monero	tezos	chainlink	cardano	singularitynet	uniswap	litecoin	pancakeswap	polkadot	ocean protocol	solana	bnb	oasis network
2019-04-14	6	0	3	5	3	11	1	22	15	5	4	8	0	16	0	6	13	9	60	5
2019-04-21	5	0	3	0	3	12	1	21	11	5	3	15	0	15	0	6	14	8	57	4
2019-04-28	6	0	3	4	3	11	1	23	8	4	3	10	0	15	0	6	32	8	53	2
2019-05-05	6	0	3	0	3	14	1	23	8	6	3	0	0	17	0	6	22	8	54	3
2019-05-12	14	1	7	0	7	23	1	29	13	8	5	9	0	26	0	6	10	9	56	5
2019-05-19	8	0	4	0	5	17	1	26	9	12	4	0	0	23	0	6	12	8	60	4
2019-05-26	11	0	5	6	5	19	1	28	9	10	4	7	0	30	0	5	10	8	60	2
2019-06-02	8	0	4	0	3	15	1	25	8	7	4	10	0	23	0	5	11	8	63	3
2019-06-09	7	0	5	0	3	15	1	24	8	14	3	8	0	41	0	6	7	8	64	5
2019-06-16	10	0	5	0	5	20	1	29	10	14	4	0	0	32	0	6	6	8	64	5
2019-06-23	13	1	6	0	7	31	1	40	9	33	4	7	0	34	0	7	5	8	64	5
2019-06-30	7	1	5	0	6	21	1	29	12	29	3	0	0	27	0	6	14	8	64	4
2019-07-07	8	1	5	0	10	20	1	29	10	18	3	6	0	26	0	7	7	9	67	3
2019-07-14	6	0	4	0	14	21	1	25	7	13	3	8	0	26	0	7	0	8	64	7
2019-07-21	6	0	3	0	3	16	1	22	7	10	3	8	0	21	0	6	0	9	63	3
2019-07-28	5	0	4	0	3	15	1	21	13	11	2	10	0	23	0	6	0	9	64	3

# EDA

**Target:** Conduct [exploratory data analysis \(EDA\)](#) on the dataset. What valuable insights can be derived from this analysis?

**Data Preparation Process** ([Prices](#)):

**Data Integration:** To streamline the analysis process and establish a unified dataset, all individual prices CSV files were merged into a single file.

Date	Open	High	Low	Close	Adj Close	Volume	Symbol
2017-11-09	0.02516	0.03506	0.025006	0.032053	0.032053	18716200	ADA
2017-11-10	0.032219	0.033348	0.026451	0.027119	0.027119	6766780	ADA
2017-11-11	0.026891	0.029659	0.025684	0.027437	0.027437	5532220	ADA
2017-11-12	0.02748	0.027952	0.022591	0.023977	0.023977	7280250	ADA
2017-11-13	0.024364	0.0263	0.023495	0.025808	0.025808	4419440	ADA
2017-11-14	0.025797	0.026788	0.025342	0.02623	0.02623	3033290	ADA
2017-11-15	0.026116	0.027773	0.025261	0.026445	0.026445	6858800	ADA
2017-11-16	0.026583	0.02817	0.025654	0.02758	0.02758	4888130	ADA
2017-11-17	0.027143	0.027436	0.025184	0.025773	0.025773	3578870	ADA
2017-11-18	0.025597	0.027122	0.024748	0.026369	0.026369	2930550	ADA
2017-11-19	0.026243	0.028478	0.025581	0.028084	0.028084	4725050	ADA
2017-11-20	0.028152	0.0323	0.027612	0.029581	0.029581	16172400	ADA

# EDA

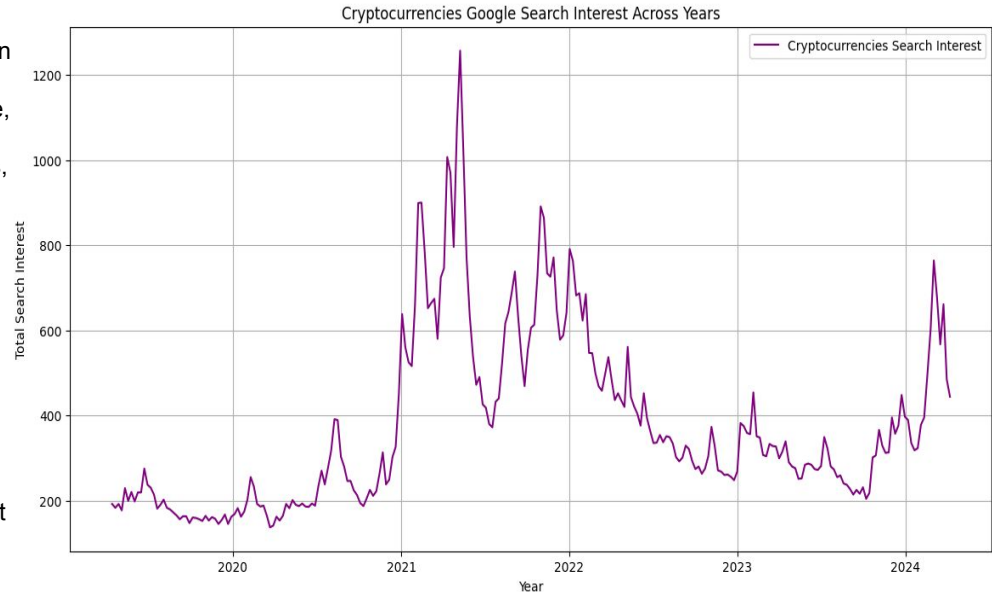
**Target:** Conduct [exploratory data analysis \(EDA\)](#) on the dataset. What valuable insights can be derived from this analysis?

## Google Trends Evolution - [Years](#)

The Google Trends analysis shows a consistent **upward** trend in interest since 2019, peaking notably in 2021. Although there was a slight decline in 2022 and 2023, interest surged again in 2024.

**2021 witnessed the highest level of interest in cryptocurrency** to date, potentially attributed to a multitude of factors, including:

1. **Increased Mainstream Adoption:** More businesses, institutions, and individuals started accepting and investing in cryptocurrencies, bolstering their legitimacy and popularity.
2. **Institutional Investment:** Large financial institutions and corporations, such as **Tesla** and **Square**, began allocating significant portions of their assets to cryptocurrencies, signaling growing institutional acceptance.
3. **Market Speculation:** Heightened media coverage and speculation surrounding cryptocurrencies, fueled by events like the rise of **meme coins** and **celebrity endorsements**, attracted a surge of retail investors seeking quick profits.
4. **DeFi and NFT Boom:** The explosive growth of decentralized finance (**DeFi**) platforms and non-fungible tokens (**NFTs**) brought new utility and excitement to the crypto space, drawing in a broader audience.
5. **Global Economic Uncertainty:** Amid economic uncertainties stemming from the COVID-19 pandemic, low interest rates, and inflation concerns, many investors turned to cryptocurrencies as a hedge against traditional financial risks.



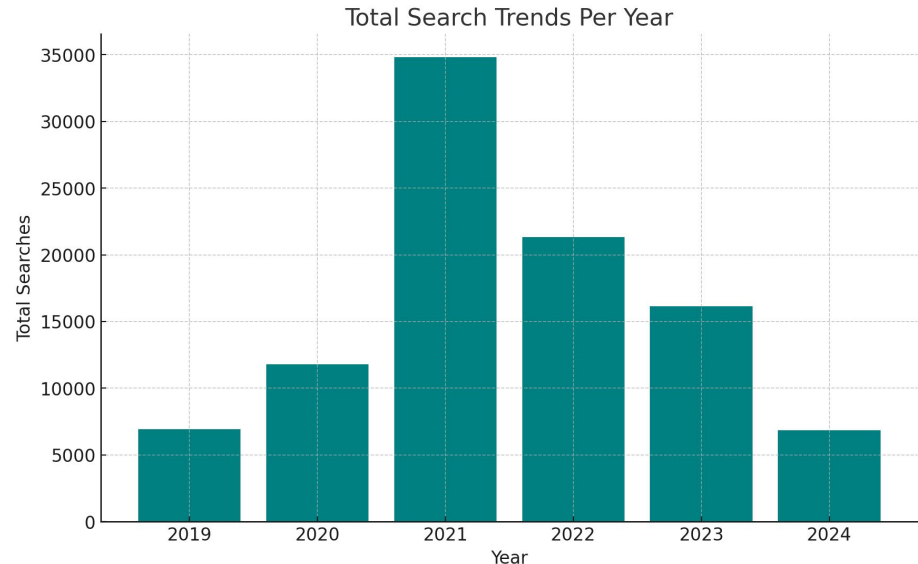
# EDA

**Target:** Conduct [exploratory data analysis \(EDA\)](#) on the dataset. What valuable insights can be derived from this analysis?

## Google Trends Evolution - [Years](#)

The significant decrease in cryptocurrency search interest from 2021 to date, could be attributed to several factors:

1. **Maturing Market:** As the cryptocurrency market matures, investors and enthusiasts may become more knowledgeable and reliant on alternative sources of information, such as specialized news websites, forums, social media platforms, and community discussions. This could reduce the reliance on Google searches for cryptocurrency-related information.
2. **Platform Diversity:** With the proliferation of cryptocurrency-focused platforms and resources, individuals may diversify their sources of information beyond general search engines like Google. They may prefer platforms tailored specifically to cryptocurrency news, analysis, and discussions, where they can access more targeted and in-depth information.
3. **Social Media Influence:** Social media platforms play a significant role in shaping cryptocurrency trends and discussions. Platforms like **Twitter**, **Reddit**, and specialized cryptocurrency forums often serve as hubs for real-time news, market analysis, and community interactions. Consequently, individuals may rely more on these platforms for information rather than traditional search engines.
4. **Direct Access to Exchanges and Wallets:** Many cryptocurrency investors and traders use exchanges and wallet applications that provide direct access to market data, price charts, and news updates. These platforms often offer integrated features that cater to users' informational needs, reducing the need for external searches.



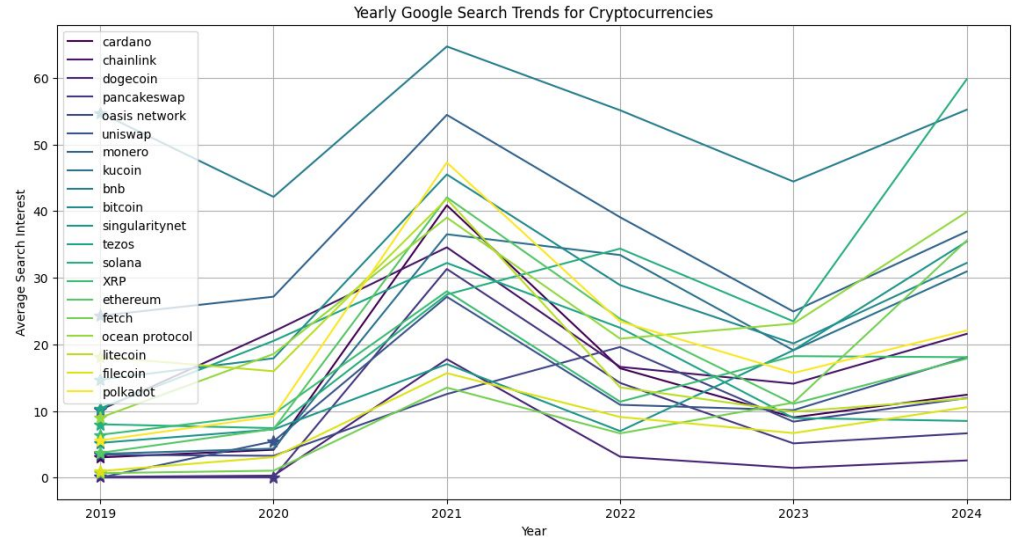
# EDA

**Target:** Conduct [exploratory data analysis \(EDA\)](#) on the dataset. What valuable insights can be derived from this analysis?

## Google Trends Evolution - [Years](#)

**Ethereum** and **Bitcoin** have consistently maintained **high** trend scores, reflecting a robust and enduring interest throughout the years. Notably, Ethereum, alongside Bitcoin, experienced a pronounced peak in interest in 2021, highlighting their prominence in the cryptocurrency market.

Meanwhile, newer or less established cryptocurrencies such as **Dogecoin** and **Pancakeswap** also experienced notable spikes in their search trends during 2021. These spikes may be attributed to particular market developments or significant influences from social media platforms during that period, suggesting a responsive and dynamic interaction between market events and public interest in these digital currencies.



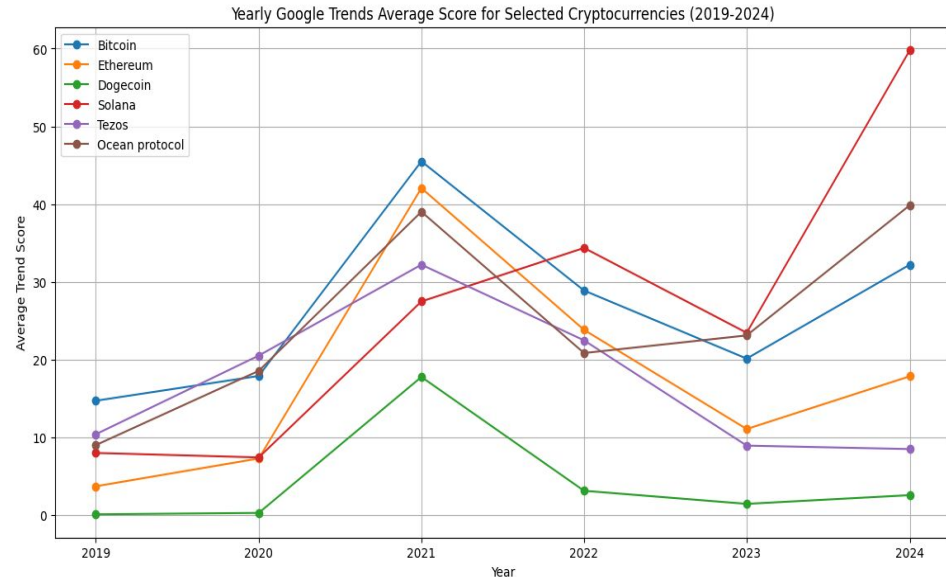
# EDA

**Target:** Conduct [exploratory data analysis \(EDA\)](#) on the dataset. What valuable insights can be derived from this analysis?

## Google Trends Evolution - [Years](#)

### Specific Insights:

1. **Bitcoin** and **Ethereum** show strong and relatively stable interest across the years, with a notable peak in 2021.
2. **Solana** shows a **remarkable increase** in interest in **2024**, indicating a surge in popularity or key developments affecting its visibility.
3. **Ocean Protocol** shows varying interest levels, with a noticeable **rise** in 2021 and another in **2024**.
4. **Chainlink** had their highest averages in 2021, matching the general trend across most cryptocurrencies.
5. **Tezos**, similar to others, peaked in 2021 but then settled back to lower levels of interest.
6. **Dogecoin** experienced a significant spike in 2021, likely influenced by social media and celebrity endorsements during that period.





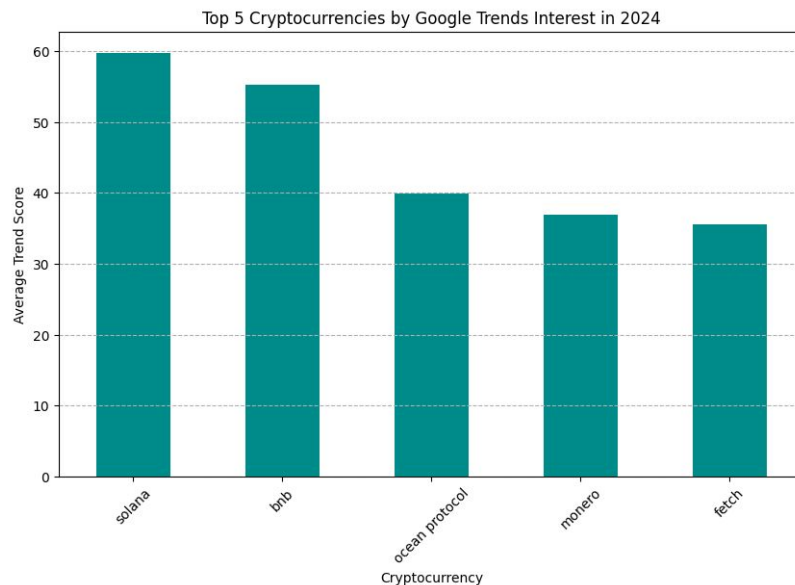
# EDA

**Target:** Conduct [exploratory data analysis \(EDA\)](#) on the dataset. What valuable insights can be derived from this analysis?

## Google Trends Evolution - [2024](#)

In 2024, the cryptocurrencies with the highest average Google Trends scores are:

1. Solana: 59.79
2. BNB: 55.21
3. **Ocean Protocol: 39.86** 🧠🔍
4. Monero: 36.93
5. Fetch: 35.57
6. SingularityNET: 35.43
7. Bitcoin: 32.21
8. Kucoin: 30.93
9. Polkadot: 22.07
10. Chainlink: 21.57



# EDA

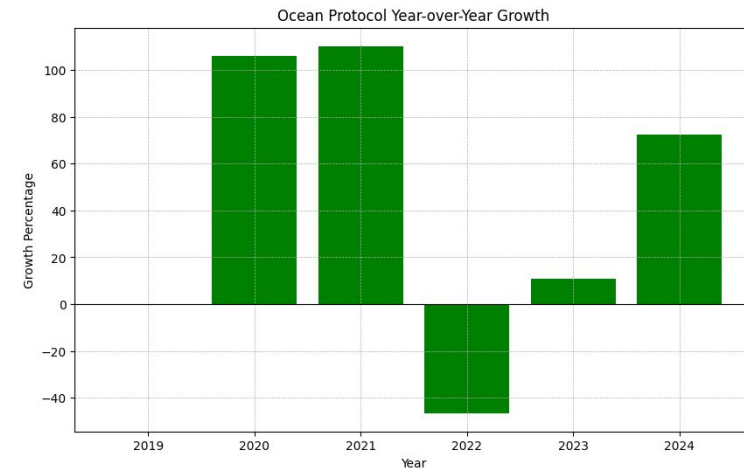
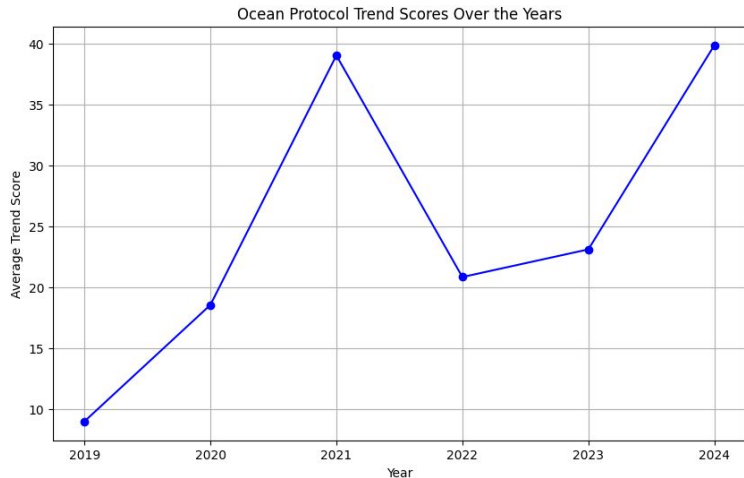
**Target:** Conduct [exploratory data analysis \(EDA\)](#) on the dataset.  
What valuable insights can be derived from this analysis?

## Google Trends Evolution - [Ocean Protocol](#)

The analysis of Google Trends data for Ocean Protocol reveals a significant increase in interest, particularly noted in **2024**. This rise in trend scores suggests a growing awareness and potential adoption of Ocean Protocol within the cryptocurrency and data sharing communities. The year-over-year growth rate provides a clear indication of how interest has surged compared to previous years.

The month with the highest search interest for Ocean Protocol was **March 2024**, with a search volume of 316.

The **Superintelligence Alliance** helped (kudos for it 🙌), but clearly Ocean Protocol was on a **steady upward trend before**.



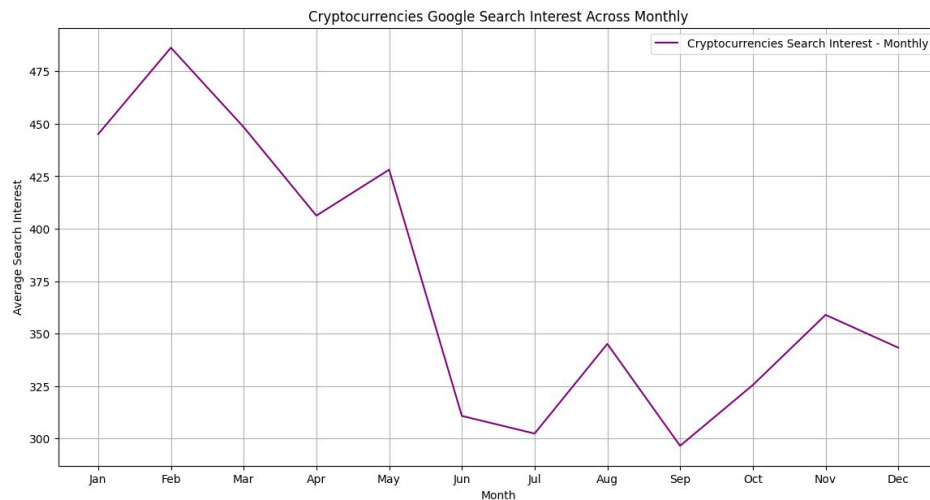
# EDA

**Target:** Conduct [exploratory data analysis \(EDA\)](#) on the dataset. What valuable insights can be derived from this analysis?

## Google Trends Evolution - [Months](#)

The Google Trends analysis reveals the peak times of cryptocurrency searches throughout the months. It's evident that the most active months span from the **beginning of the year through May**, with another notable increase in activity towards the **end of the year** and **February** consistently stands out as the month with the **highest** level of activity. This could be due to:

1. **Market Cycles:** Historically, the cryptocurrency market often experiences heightened activity and price volatility in the first half of the year, driven by various factors such as investor speculation, market sentiment, and trading volumes. This increased activity could lead to a surge in searches as individuals seek information and insights into market trends.
2. **Tax Season:** In many countries, May coincides with tax season deadlines. During this time, individuals may research cryptocurrency taxation guidelines, implications, and reporting requirements, leading to an uptick in search activity related to cryptocurrencies.
3. **Seasonal Trends:** Consumer behavior and interest in cryptocurrencies may be influenced by seasonal trends or patterns, similar to other financial markets. The beginning of the year often marks a period of renewed interest and resolutions, including financial goals and investments, which could contribute to increased cryptocurrency search activity.



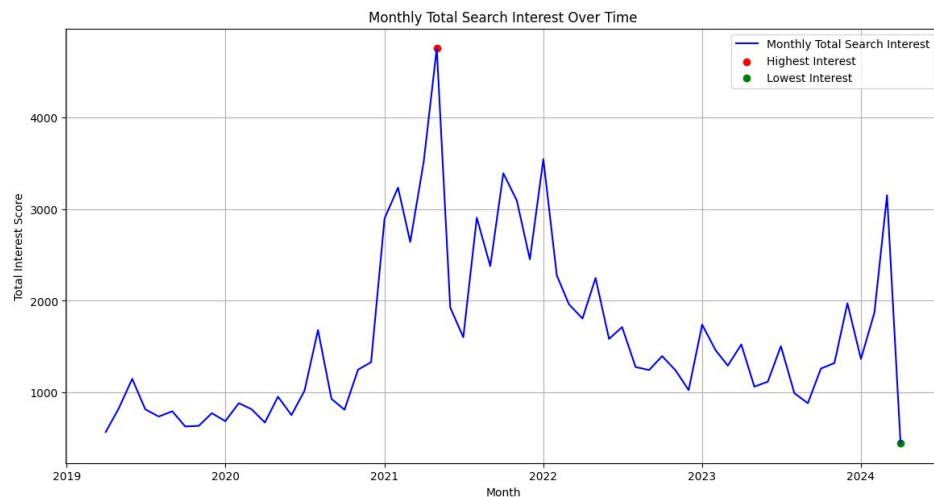
# EDA

**Target:** Conduct [exploratory data analysis \(EDA\)](#) on the dataset. What valuable insights can be derived from this analysis?

## Google Trends Evolution - [Months](#)

The discrepancy in search interest between May 2021, the month with the highest interest, and April 2024 (**Please take this with a grain of salt as April is still ongoing**), the month with the lowest interest, may be influenced by several factors:

1. **Market Conditions:** May 2021 was a period of significant volatility and price appreciation in the cryptocurrency market, particularly for **Bitcoin** and other major cryptocurrencies. Heightened market activity and media coverage during this time may have spurred increased interest and search queries from both experienced investors and newcomers seeking to capitalize on market trends.
2. **Media Attention:** Major news events and developments in the cryptocurrency space can impact search interest. May 2021 saw widespread media coverage of topics such as **Elon Musk's tweets** about Bitcoin, institutional adoption, regulatory discussions, and the **emergence of decentralized finance (DeFi)** projects, which likely attracted more attention and search queries.
3. **Seasonal Trends:** Seasonal factors may also play a role in search interest fluctuations. May often marks the transition from spring to summer in many regions, coinciding with increased leisure time and online activity.



# EDA

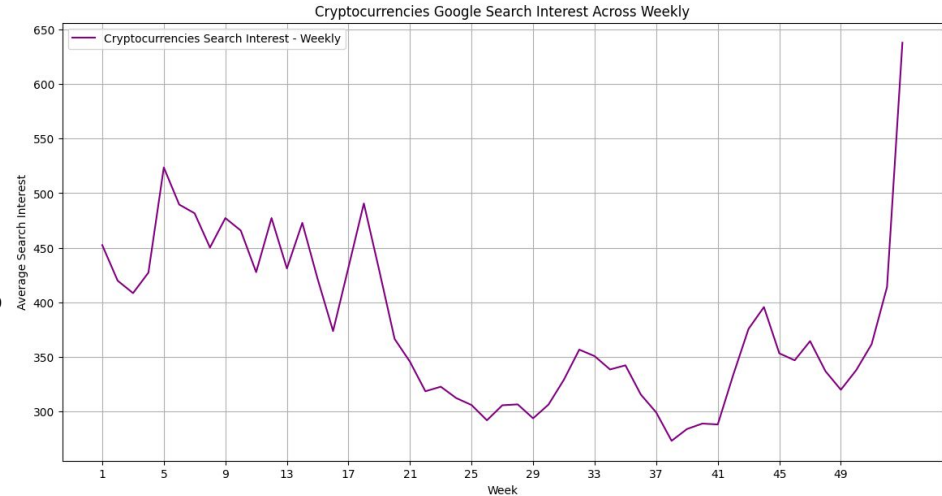
**Target:** Conduct [exploratory data analysis \(EDA\)](#) on the dataset. What valuable insights can be derived from this analysis?

## Google Trends Evolution - [Weeks](#)

The Google Trends analysis uncovers the peak periods of cryptocurrency searches on a weekly basis. While the monthly view provides an overview of the pattern, the weekly analysis reveals intriguing insights. **Notably, the most active weeks are the first week of January, February, March, May and November.**

The observed pattern of increased cryptocurrency search activity at the beginning of each month could be influenced by several factors:

1. **Paycheck Timing:** Many individuals receive their paychecks at the beginning of the month. This influx of disposable income could lead to increased interest and investment activity in cryptocurrencies as people allocate funds to various assets, including digital currencies.
2. **Budgeting and Planning:** At the start of a new month, people often review their finances, set financial goals, and plan their spending. This may prompt individuals to research investment opportunities, including cryptocurrencies, as part of their financial planning process.
3. **Market Analysis and Strategy:** Traders and investors may adopt a monthly strategy, reassessing market conditions and adjusting their investment portfolios at the beginning of each month.
4. **Psychological Factors:** The start of a new month may evoke a sense of renewal and opportunity, motivating individuals to explore new ventures or investment opportunities, such as cryptocurrencies.



# EDA

**Target:** Conduct [exploratory data analysis \(EDA\)](#) on the dataset. What valuable insights can be derived from this analysis?

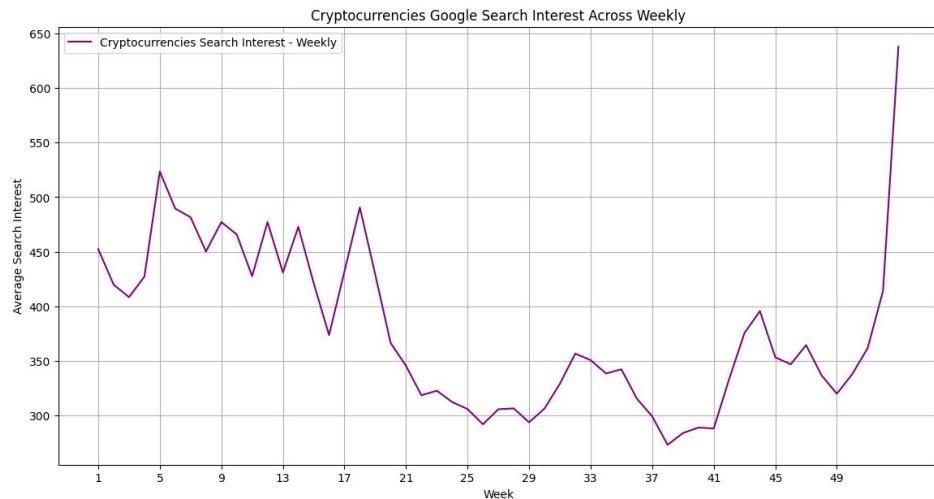
## Google Trends Evolution - [Weeks](#)

### Week with the Highest Search Interest

- Date: May 9, 2021
- Total Interest: 933
- Key Cryptocurrencies:
  - **BNB, Cardano, Ethereum, Uniswap, Pancakeswap, Dogecoin: 100 each**
  - Litecoin, Monero: 90 and 91 respectively
  - Bitcoin, Chainlink: 58 each

### Week with the Lowest Search Interest

- Date: March 22, 2020
- Total Interest: 137
- Most active cryptocurrencies had significantly lower scores compared to the peak:
  - Bitcoin: 18
  - Ethereum: 4
  - Litecoin, Monero: 14 and 22 respectively



# Past vs Current Trends Cycles

**Target:** Contrast present Google Trends data with those from preceding cycles. What does this comparative analysis unveil regarding the ongoing cycle?

## Trends in Cryptocurrency Interest Over Time

Historical data from Google Trends often shows clear cycles of peaks and troughs in interest towards cryptocurrencies. These cycles typically correlate with market booms and busts, major technological announcements, regulatory changes, or macroeconomic factors affecting liquidity and investment sentiment. For instance, significant peaks in interest often coincide with bull market phases, where rising prices attract more public attention and new investors, while troughs may align with bearish markets or periods of regulatory uncertainty.

## Characteristics of the Current Cycle

The ongoing cycle, particularly highlighted by data from 2024, shows a resurgence in interest that surpasses many previous peaks for certain cryptocurrencies like **Ocean Protocol**. This surge might indicate a few key trends:

- **Market Recovery or New Developments:** After periods of lower interest and market consolidation, a sharp increase could suggest a recovery phase or excitement about new technological innovations or applications within the cryptocurrency space.
- **Wider Adoption and Integration:** Increased scores may reflect broader adoption of cryptocurrencies and blockchain technology in mainstream finance and other industries, suggesting that digital assets are becoming more integral to various business operations and everyday transactions.

# Past vs Current Trends Cycles

**Target:** Contrast present Google Trends data with those from preceding cycles. What does this comparative analysis unveil regarding the ongoing cycle?

## Comparative Analysis with Previous Cycles

Comparing the current cycle with those from previous years, we see that while earlier cycles were often driven by speculative trading and the novelty of cryptocurrencies, current trends might be bolstered by more substantial factors such as:

- **Institutional Investment:** More significant involvement by institutional investors, which stabilizes and drives long-term growth(e.g Bitcoin & Ethereum ETFs)
- **Technological Maturation:** Enhanced functionality, scalability, and security of blockchain platforms making them more viable for widespread use.
- **Regulatory Clarity:** Gradual progress towards more defined regulatory frameworks in key markets, reducing uncertainty and encouraging both consumer and business adoption.
- **Partnerships:** Partnerships can significantly impact the crypto market by fostering trust, driving adoption, and enhancing utility for digital assets.

The ongoing cycle's distinctive features suggest a **maturing** market where cryptocurrencies are not just speculative assets but are increasingly viewed as **viable components** of **diversified portfolios** and **functional technologies for decentralization**. This phase likely reflects a deeper and more **stable** integration of crypto assets into the economic and technological landscape, hinting at a robust future trajectory compared to the more volatile past cycles.



# Past vs Current Trends Cycles

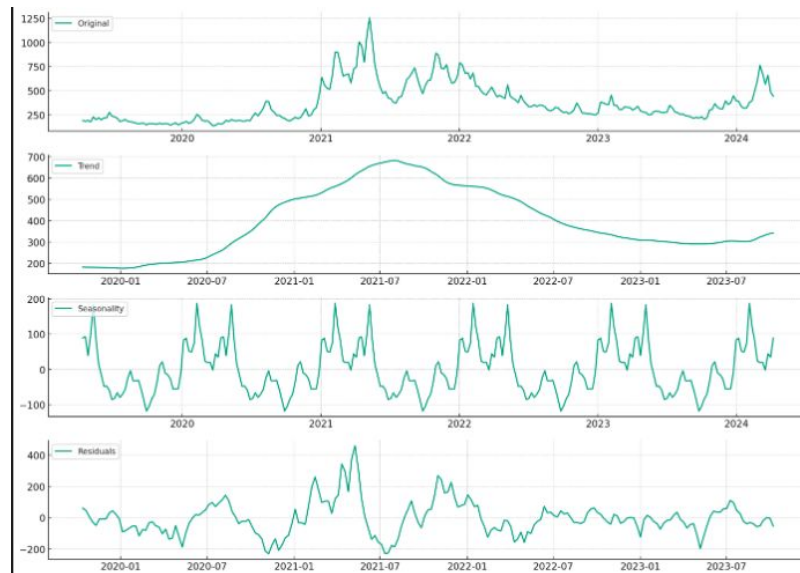
**Target:** Contrast present Google Trends data with those from preceding cycles. What does this comparative analysis unveil regarding the ongoing cycle?

**Original:** The overall trend shows some peaks and troughs, indicating fluctuations in interest over time.

**Trend:** This line smooths out the data to show long-term movements. We see periods of rise and fall, which could correspond to bull and bear markets.

**Seasonality:** This indicates any seasonal patterns. However, the seasonality does not show very strong or clear patterns in this case, suggesting that search interest might not be strongly seasonal on a yearly basis.

**Residuals:** These represent the noise or random variations after removing the trend and seasonality. Large spikes here might indicate specific events impacting search interest.



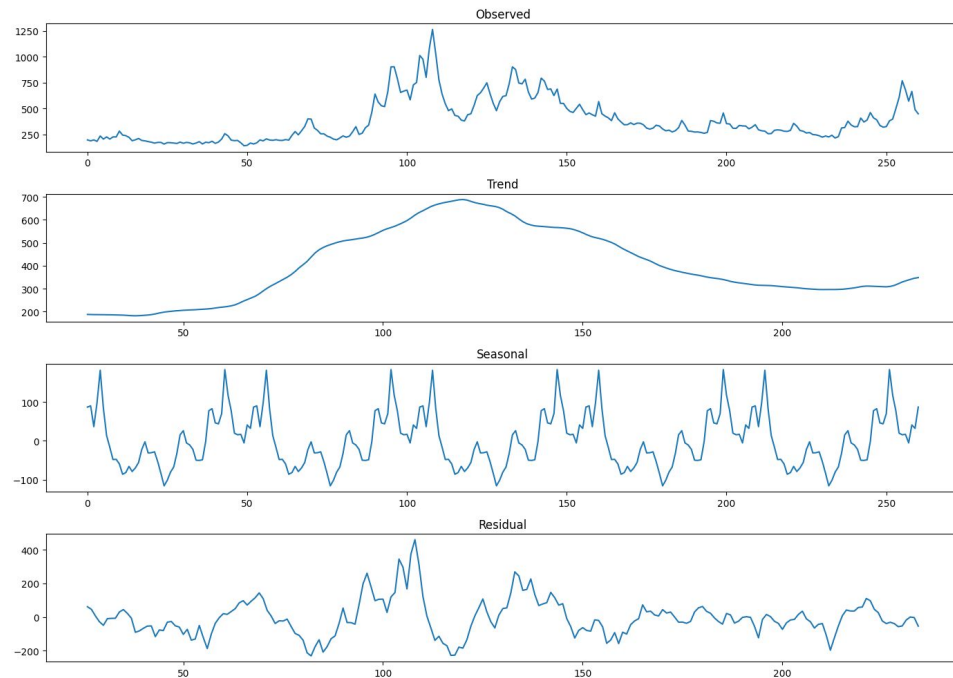
# Past vs Current Trends Cycles

**Target:** Contrast present Google Trends data with those from preceding cycles. What does this comparative analysis unveil regarding the ongoing cycle?

## 2021 - 2024 comparison:


The aggregated data indicates some notable trends in cryptocurrency interest levels between the spike of 2021 and 2024. Here are some key observations:

- **Bitcoin:** Interest **decreased** from an average of about 45.5 in 2021 to about 28.9 in the end of 2023 and start of 2024.
- **Ethereum:** Also showed a **decline**, from approximately 42.1 to 15.9.
- **Cardano:** Experienced a **significant decrease** from 40.9 to 12.9.
- **Solana:** In contrast to the downward trends in many other coins, Solana's interest **increased** dramatically, from 27.5 in 2021 to 56.5 in the recent period.

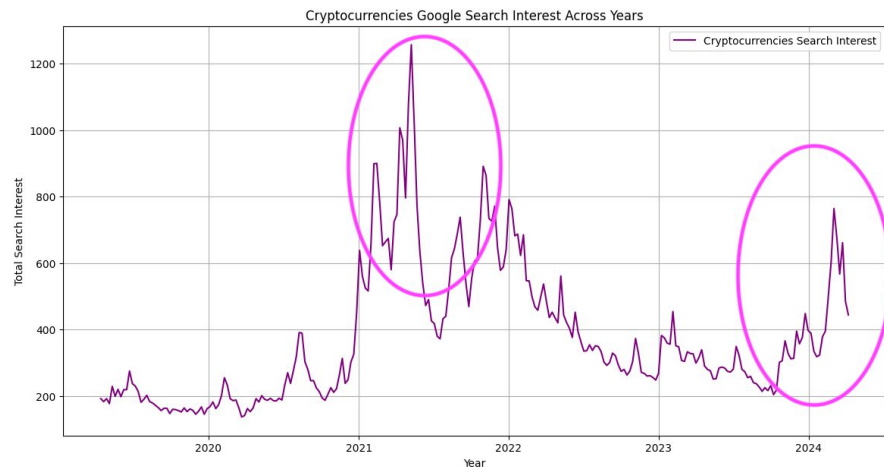
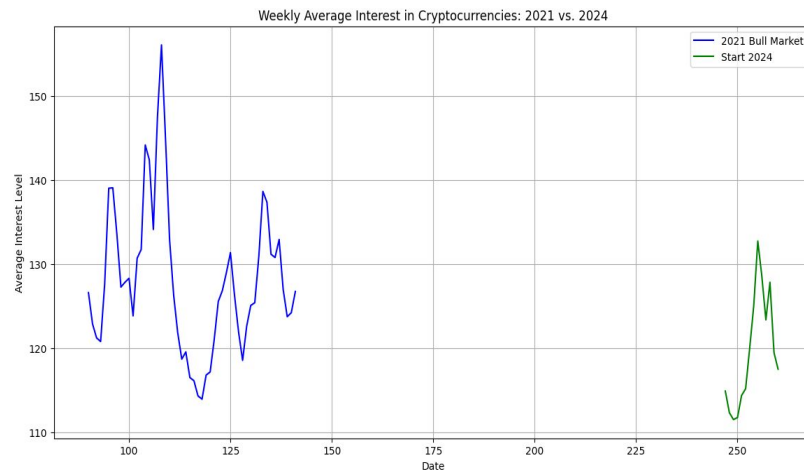


# Past vs Current Trends Cycles

**Target:** Contrast present Google Trends data with those from preceding cycles. What does this comparative analysis unveil regarding the ongoing cycle?

**i** Notably, there is an observable upward trend beginning in 2024, similar to the trend observed in 2021, which could suggest the onset of a potential search interest (that according to history is correlated with a bull market). If this trend respects the seasonality, at the end of May-June, the interest will start going down. 

Considering that this year is also an election year in the USA—a significant event in terms of investment and public attention—some of the focus may shift towards political developments. Beginning in June, the data indicates a downward trend in searches related to the crypto market, possibly as a result of increased interest in the elections.



# Token Price vs Trends

**Target:** Determine the [correlation](#) between token prices and their associated Google Trends. What are the implications of this correlation?

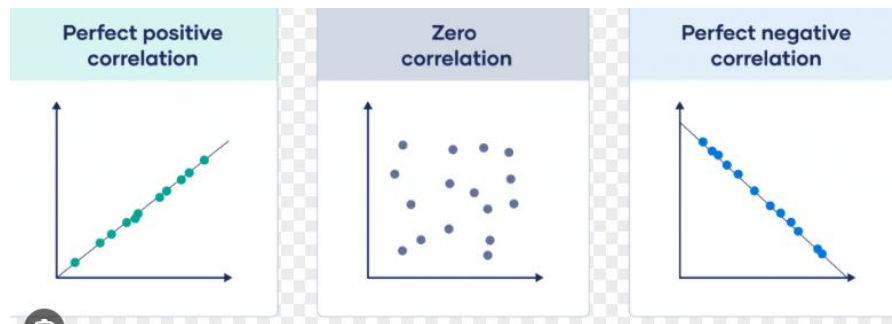
**Correlation Calculation:** Calculate the correlation between the '**Close**' prices from the weekly price dataset and the corresponding Google Trends scores from the trends dataset for each cryptocurrency.

## Explanation of the Numbers

The correlation coefficient measures the strength and direction of a linear relationship between two variables. Here's what the values mean:

- **+1.0:** A perfect positive correlation, meaning that as one variable increases, the other also increases.
- **0.0:** No correlation, implying that the movements of one variable do not predict the movements of the other.
- **-1.0:** A perfect negative correlation, indicating that as one variable increases, the other decreases.

Values closer to +1 or -1 signify a **strong correlation**. In general, a correlation greater than 0.5 or less than -0.5 can be considered strong, particularly in financial data where multiple factors influence prices.



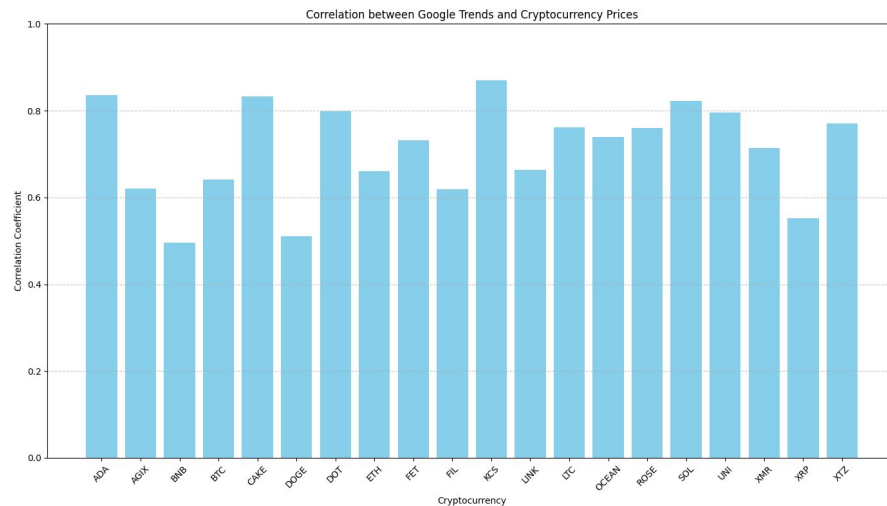
# Token Price vs Trends

**Target:** Determine the [correlation](#) between token prices and their associated Google Trends. What are the implications of this correlation?

The analysis of the correlation between cryptocurrency token **prices** and their associated Google **Trends** scores reveals several significant insights into the dynamics of the cryptocurrency market. By examining this relationship, we observe that there is often a notable correlation between the two. This means that as interest in a cryptocurrency increases, as evidenced by search volume on Google, there is typically a corresponding increase in its price. This is also confirmed by this [paper](#).

## Key Findings:

- **Positive Correlation:** Most cryptocurrencies, such as **ADA** (Cardano), **CAKE** (PancakeSwap), and **KCS** (KuCoin), show strong positive correlations. This indicates that **spikes in public interest or search volume often coincide with price increases**. This pattern can be attributed to the influx of new investors and traders who enter the market as they learn about and gain interest in specific tokens.
- **Implications for Market Sentiment:** The correlation suggests that Google Trends can be a useful proxy for market sentiment. High search volumes may signal a growing interest in a cryptocurrency, possibly preceding price rallies. Conversely, a decline in search volume might predict decreasing prices or a loss of interest, potentially serving as a warning signal for investors.

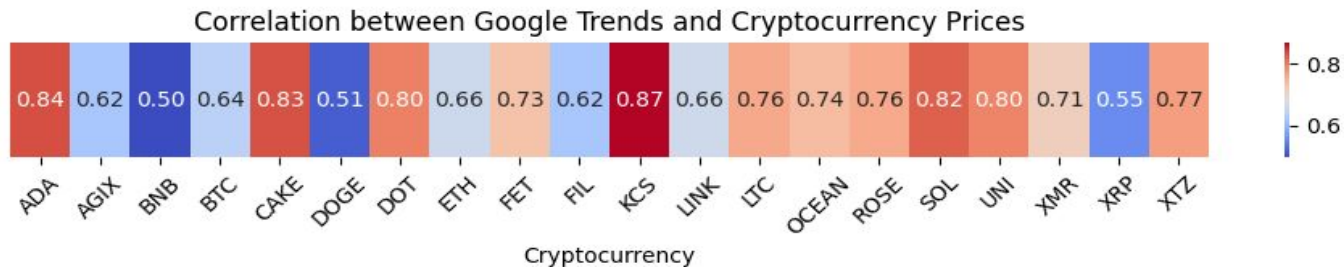


# Token Price vs Trends

**Target:** Determine the [correlation](#) between token prices and their associated Google Trends. What are the implications of this correlation?

## Key Findings:

- **Volatility and Speculation:** Cryptocurrencies with very high correlations might be subject to high volatility, as their market prices could be heavily influenced by public sentiment and speculative trading. This means that news, social media hype, and other factors that affect public perception can result in quick and significant price movements.
- **Strategic Trading and Investment:** For traders and investors, understanding these correlations can aid in developing more informed strategies.
- **Predictive Analytics:** Integrating Google Trends data into predictive models could enhance the accuracy of forecasting future price movements. However, traders should be cautious, as correlation does not equate to causation, and other market factors should always be considered.
- **Risk Management:** Awareness of the correlation between search trends and prices can improve risk management strategies. Investors can monitor Google Trends to gauge the potential impact of public interest on market volatility and adjust their investment portfolios accordingly.
- **Broader Market Analysis:** Extending this analysis to include different regions and comparing local versus global search trends can provide deeper insights. For example, regulatory announcements in a particular country might spike localized interest and affect global prices, highlighting the interconnected nature of cryptocurrency markets.



# Token Price vs Trends

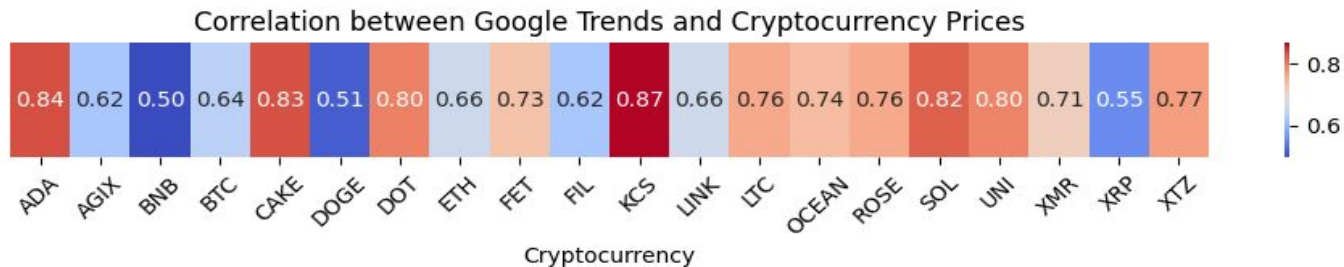
**Target:** Determine the [correlation](#) between token prices and their associated Google Trends. What are the implications of this correlation?

**Conclusion:**

Among the 20 coins analysed, findings reveal varied degrees of correlation:

- 6 coins show a positive strong correlation ( $>0.80$ )
- 6 coins show a positive correlation ( $>0.70$ )
- 5 coins show a correlation ( $>0.50$ )

Overall, the data indeed indicates a positive correlation between Google Trends and the price movements of a coin.



# Token Price vs Trends

**Target:** Determine the [correlation](#) between token prices and their associated Google Trends. What are the implications of this correlation?

**Is this relationship bidirectional?**



Increases in cryptocurrency prices lead also to more searches on Google?



# Token Price vs Trends

**Target:** Determine the [correlation](#) between token prices and their associated Google Trends. What are the implications of this correlation?

## Methods to Explore Bidirectionality:

**Time Lag Analysis:** By shifting Google Trends data forward (to predict future price movements) and cryptocurrency prices backward (to see if past price increases influenced search volume), we can calculate correlation coefficients for different time lags. This helps to see if changes in one precede changes in the other.

**Granger Causality Test:** This statistical test can be used to check if one time series is useful in forecasting another. If Google Trends data can forecast price changes or if price changes can forecast Google Trends data, it would suggest a bidirectional relationship.

# Token Price vs Trends

**Target:** Determine the [correlation](#) between token prices and their associated Google Trends. What are the implications of this correlation?

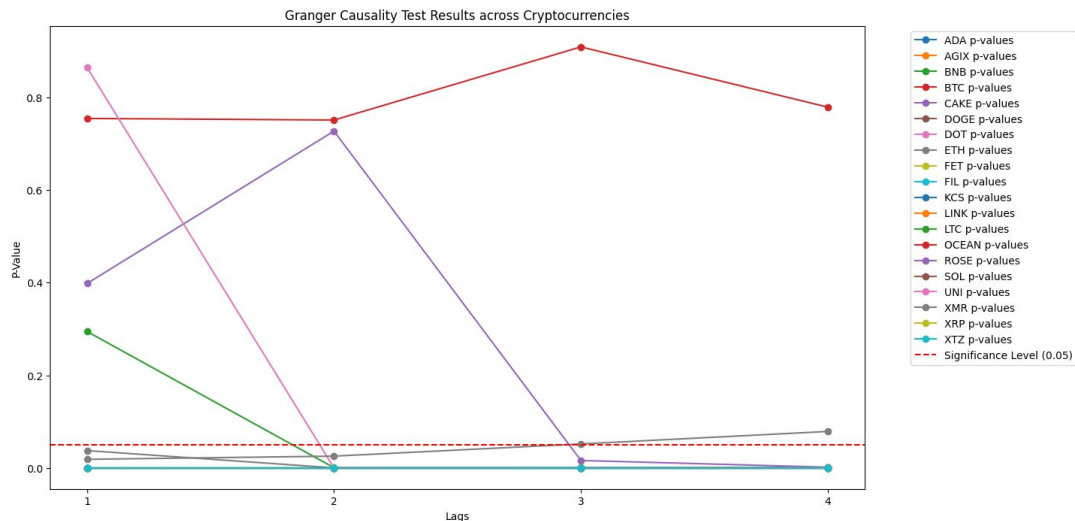
## Granger Causality Results (up to 4 lags)

Each line represents a different cryptocurrency, and the p-values for up to 4 lags are plotted. The horizontal red dashed line at  $p=0.05$  marks the conventional threshold for statistical significance.

### Interpretation of the Plot:

Cryptocurrencies whose lines remain below the red line across the lags demonstrate strong statistical evidence of a bidirectional relationship between their Google Trends data and prices.

Those that cross above the line at certain lags indicate lags where the relationship is not statistically significant.



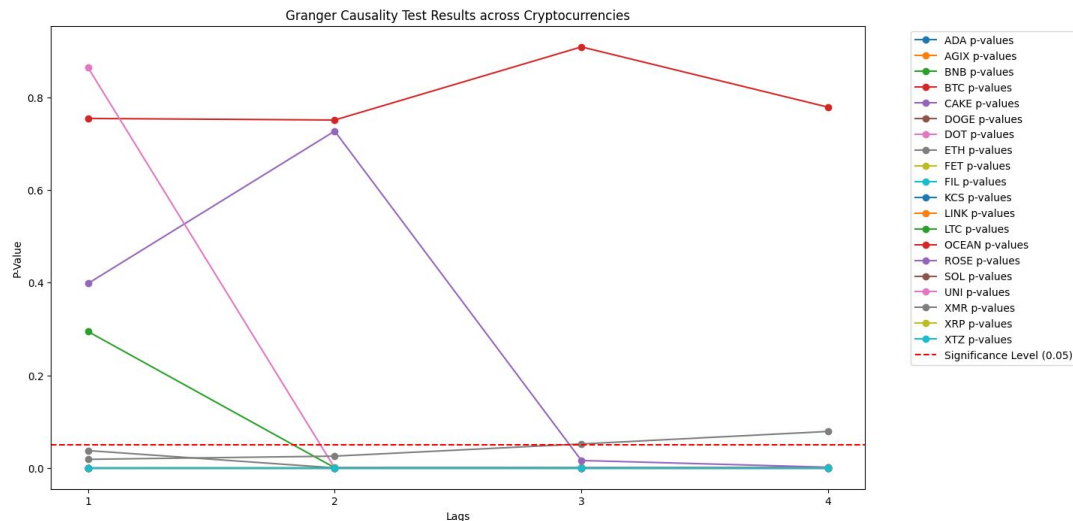
# Token Price vs Trends

**Target:** Determine the [correlation](#) between token prices and their associated Google Trends. What are the implications of this correlation?

From the Granger causality test results, the cryptocurrencies that showed **strong relationships** (i.e., consistently low p-values across all 4 lags, indicating a significant influence of Google Trends on prices) are as follows:

1. Cardano (**ADA**)
2. SingularityNET (**AGIX**)
3. Dogecoin (**DOGE**)
4. Polkadot (**DOT**)
5. Fetch.ai (**FET**)
6. Filecoin (**FIL**)
7. KuCoin (**KCS**)
8. ChainLink (**LINK**)
9. Litecoin (**LTC**)
10. Ocean Protocol (**OCEAN**)
11. Oasis Network (**ROSE**)
12. Solana (**SOL**)
13. **XRP**
14. Tezos (**XTZ**)

These cryptocurrencies demonstrated **very strong** statistical evidence of a **bidirectional relationship** between their Google Trends data and cryptocurrency prices. The **Granger causality tests** for these cryptocurrencies resulted in p-values of 0.0 across all lags tested, suggesting that changes in public search interest can predict changes in their prices and potentially vice versa.

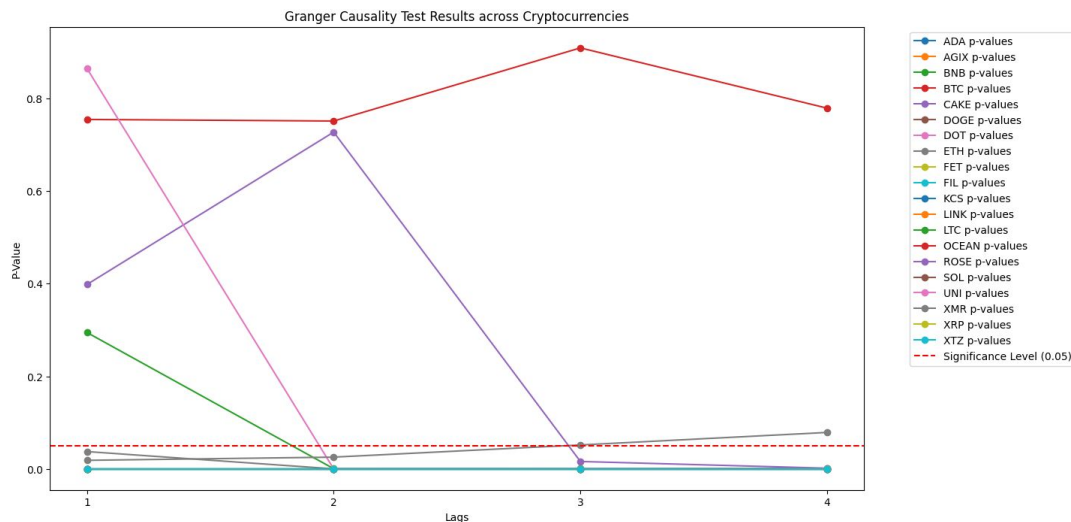


# Token Price vs Trends

**Target:** Determine the [correlation](#) between token prices and their associated Google Trends. What are the implications of this correlation?

## Implications:

- **High Sensitivity to Public Interest:** These cryptocurrencies are particularly sensitive to changes in public interest as measured by Google search volumes. This could mean that news, social media discussions, or other forms of public engagement that spike interest can significantly influence their market prices.
- **Potential for Predictive Models:** For investors and traders, these results suggest that including Google Trends data in predictive models could potentially enhance their ability to forecast price movements for these particular cryptocurrencies.
- **Market Strategy:** Knowledge of which cryptocurrencies are more influenced by public sentiment can help in developing trading strategies that capitalize on market sentiment analysis, especially during periods of heightened public attention or when significant news breaks that could impact these cryptocurrencies.

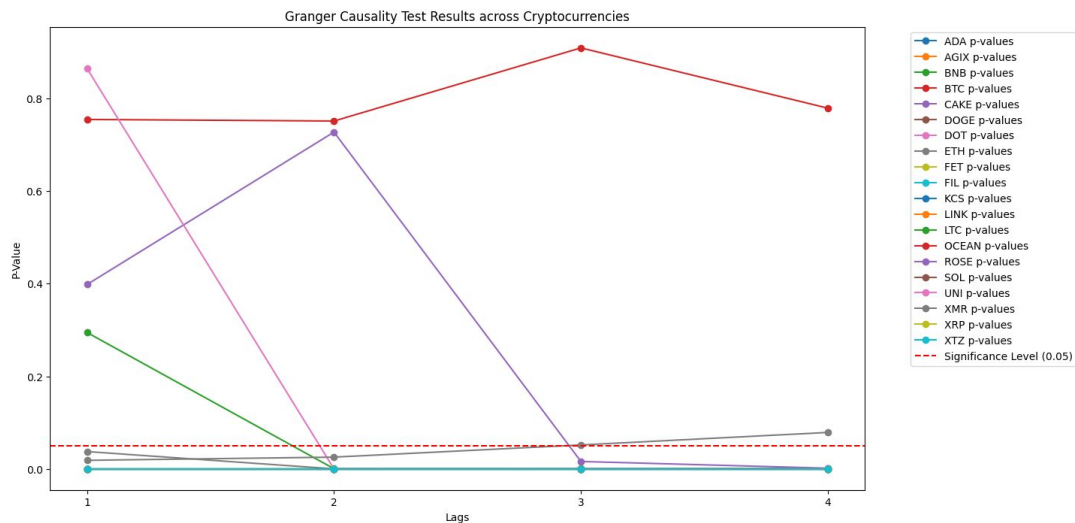


# Token Price vs Trends

**Target:** Determine the [correlation](#) between token prices and their associated Google Trends. What are the implications of this correlation?

While some coins demonstrate a strong relationship, others exhibit distinct behaviors.

1. **Binance Coin (BNB)**: Shows significant results at higher lags with p-values [0.2945, 0.0004, 0.0005, 0.0009], suggesting that at **lag 2 onwards**, the Google Trends data is statistically significant in forecasting price changes.
2. **Bitcoin (BTC)**: The p-values are [0.7545, 0.7511, 0.909, 0.7789], indicating **no significant relationship** between search trends and price changes at any of the lags tested.
3. **PancakeSwap (CAKE)**: Mixed results with p-values [0.3943, 0.7254, 0.0158, 0.0014], indicating significant results starting from **lag 3**.
4. **Ethereum (ETH)**: Strong evidence of bidirectional causality with p-values [0.0374, 0.0001, 0.0001, 0.0].
5. **Uniswap (UNI)**: Shows a significant result at **higher lags**, but with p-value [0.8645, 0.0, 0.0, 0.0], indicating **no significance at lag 1** but significant at **higher lags**.
6. **Monero (XMR)**: Moderate significance with p-values [0.0185, 0.0254, 0.0517, 0.0787], suggesting a potential but **weaker bidirectional** relationship.



# Token Price vs Trends

**Target:** Determine the [correlation](#) between token prices and their associated Google Trends. What are the implications of this correlation?

These results indicate that for most cryptocurrencies tested, there is significant evidence that **changes in Google search volume can predict price changes and vice versa**, suggesting a bidirectional relationship. This implies that public interest as reflected in search trends is closely tied to price movements in the cryptocurrency market.



# Time Lag

**Target:** Explore the ideal time lags that enhance the correlations, as mentioned earlier. What insights can be garnered from this investigation?

To explore the ideal time lags that enhance the correlations between Google Trends data and cryptocurrency prices, we analyze how the correlation coefficients vary with different time lags for each cryptocurrency.

## Steps for Exploring Ideal Time Lags:

- **Lag Introduction:** Systematically shift the Google Trends data relative to the cryptocurrency price data by different time intervals (e.g., 1 week, 2 weeks, up to 4 weeks).
- **Correlation Calculation:** Calculate the Pearson correlation coefficient for each lag to assess how the correlation changes with different time shifts.
- **Comparison and Analysis:** Identify the lag that results in the highest correlation for each cryptocurrency, indicating the potential delay between search interest peaks and corresponding price movements.



# Time Lag

**Target:** Explore the [ideal time lags](#) that enhance the correlations, as mentioned earlier. What insights can be garnered from this investigation?

## Insights:

- Most cryptocurrencies exhibit the **strongest correlation** between Google Trends data and their prices with just a **1-week lag**. This suggests that the impact of changes in search volume on prices is relatively immediate, likely within a week.
- Certain cryptocurrencies like AGIX, DOGE, FET, and KCS show significant correlations at longer lags (**2 to 4 weeks**), indicating that the effects of search trends on these cryptocurrencies' prices may take longer to materialize.

## Optimal Lags and Correlation Insights:

- **Cardano (ADA)**: Strongest correlation at a 1-week lag (Correlation: 0.868)
- **SingularityNET (AGIX)**: Strongest correlation at a 2-week lag (Correlation: 0.752)
- **Binance Coin (BNB)**: Strongest correlation at a 1-week lag (Correlation: 0.499)
- **Bitcoin (BTC)**: Strongest correlation at a 1-week lag (Correlation: 0.636)
- **PancakeSwap (CAKE)**: Strongest correlation at a 1-week lag (Correlation: 0.801)
- **Dogecoin (DOGE)**: Strongest correlation at a 4-week lag (Correlation: 0.598)
- **Polkadot (DOT)**: Strongest correlation at a 1-week lag (Correlation: 0.841)
- **Ethereum (ETH)**: Strongest correlation at a 1-week lag (Correlation: 0.672)
- **Fetch.ai (FET)**: Strongest correlation at a 2-week lag (Correlation: 0.848)
- **Filecoin (FIL)**: Strongest correlation at a 1-week lag (Correlation: 0.713)
- **KuCoin (KCS)**: Strongest correlation at a 2-week lag (Correlation: 0.885)
- **ChainLink (LINK)**: Strongest correlation at a 1-week lag (Correlation: 0.718)
- **Litecoin (LTC)**: Strongest correlation at a 1-week lag (Correlation: 0.799)
- **Ocean Protocol (OCEAN)**: Strongest correlation at a 1-week lag (Correlation: 0.811)
- **Oasis Network (ROSE)**: Strongest correlation at a 1-week lag (Correlation: 0.822)
- **Solana (SOL)**: Strongest correlation at a 1-week lag (Correlation: 0.844)
- **Uniswap (UNI)**: Strongest correlation at a 1-week lag (Correlation: 0.777)
- **Monero (XMR)**: Strongest correlation at a 1-week lag (Correlation: 0.718)
- **XRP**: Strongest correlation at a 1-week lag (Correlation: 0.645)
- **Tezos (XTZ)**: Strongest correlation at a 1-week lag (Correlation: 0.819)



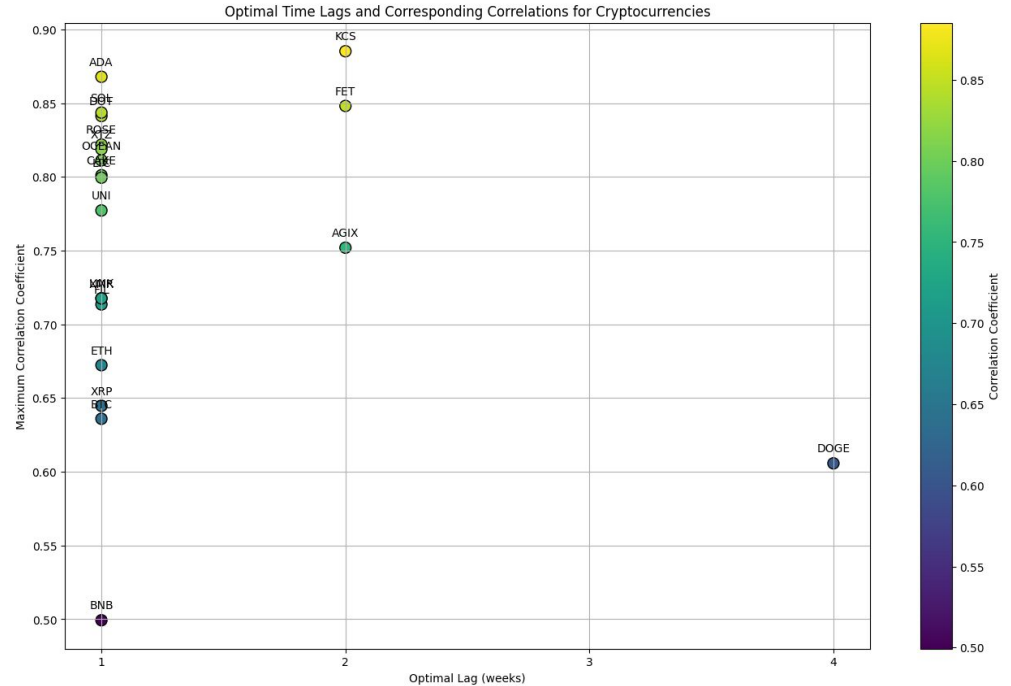
# Time Lag

**Target:** Explore the [ideal time lags](#) that enhance the correlations, as mentioned earlier. What insights can be garnered from this investigation?

## Insights:

- **Correlation Strengths:** Cryptocurrencies with very high correlations (e.g., ADA, DOT, KCS) could be more **sensitive** to changes in public interest. This sensitivity might be useful for trading strategies that capitalize on short-term price movements influenced by spikes in search volumes.
- **Trading and Investment Strategy:** Knowing the optimal lag can help traders and investors time their market entries and exits better. For instance, if a significant increase in search volume is observed, one might anticipate a price increase to follow within the time frame indicated by the optimal lag.

**i** The majority of cryptocurrencies react quite promptly (within a week) to changes in Google Trends, which can be critical for timely decision-making in trading strategies.



# Token Patterns

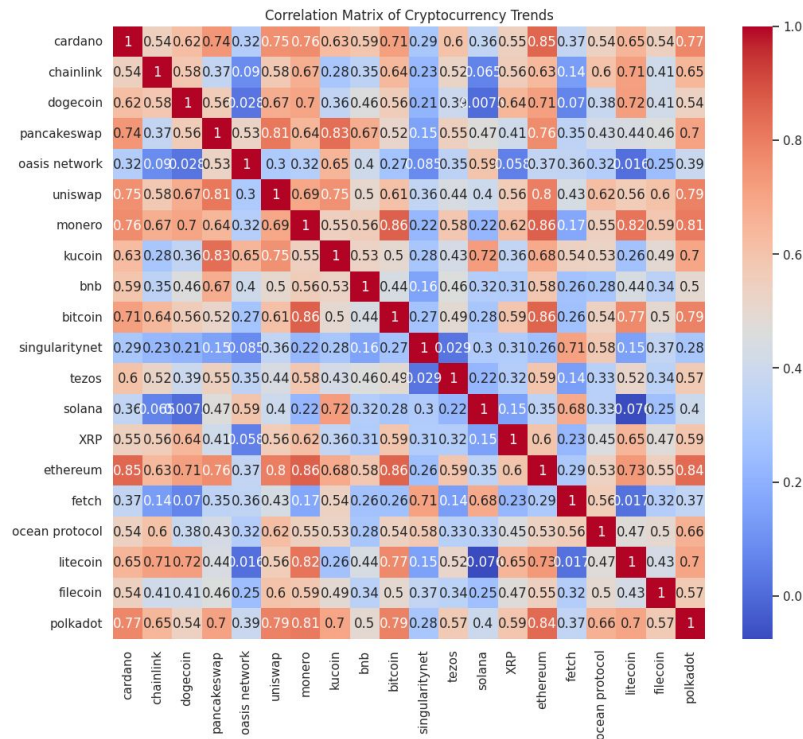
**Target:** Examine the correlation between trends of various tokens. Do they demonstrate comparable patterns?

## Top 10 Strong Correlations

1. Ethereum and Monero: **0.86**
2. Bitcoin and Monero: **0.86**
3. Bitcoin and Ethereum: **0.86**
4. Cardano and Ethereum: **0.85**
5. Ethereum and Polkadot: **0.84**
6. Pancakeswap and Kucoin: **0.83**
7. Litecoin and Monero: **0.82**
8. Pancakeswap and Uniswap: **0.81**
9. Monero and Polkadot: **0.81**
10. Ethereum and Uniswap: **0.80**

## Insights:

- **High Interdependence:** Major tokens such as Ethereum, Bitcoin, Monero, Cardano, and Polkadot show very high interdependence in their trend changes, suggesting that these tokens often experience similar fluctuations in market interest simultaneously.
- **Network Effects and Market Movements:** This high correlation may reflect broader market movements affecting these major cryptocurrencies similarly, possibly due to shared investor bases, similar market reactions to global economic events, or coordinated trading behaviors among large-scale traders.



# Token Patterns

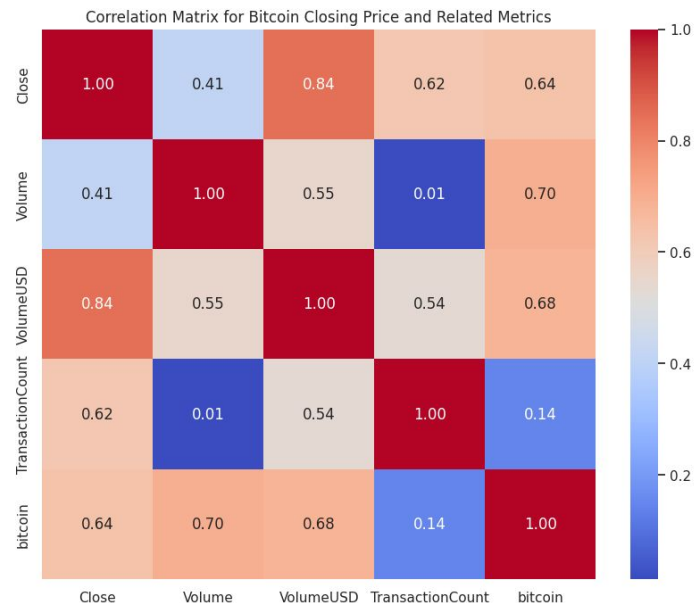
**Target:** Examine the correlation between trends of various tokens. Do they demonstrate comparable patterns?

**Bitcoin [Insights](#)** (Price - Volume - Transactions)

## Legend:

- 0.0 to 0.2: Very weak correlation
- 0.2 to 0.4: Weak correlation
- 0.4 to 0.6: Moderate correlation
- 0.6 to 0.8: Strong correlation
- 0.8 to 1.0: Very strong correlation

- **Price and Volume:** The correlation between the closing price and trading volume is moderate (about 0.41). This suggests that price changes are somewhat associated with changes in trading volume.
- **Price and Volume USD:** There is a **strong positive correlation** (approximately 0.84) between the closing price and the transaction volume in USD. Higher closing prices tend to be associated with higher transaction volumes in dollar terms.
- **Price and Transaction Count:** The correlation between the closing price and the number of transactions is moderate (around **0.62**). This indicates that as the price increases, there might be a tendency for the number of transactions to increase, but the relationship isn't as strong as with the transaction volume in USD.
- **Price and Bitcoin Trend:** The correlation is also moderately strong (about **0.64**) between the closing price and Bitcoin trend data. This suggests that increases in the closing price are often accompanied by increased interest or search trends related to Bitcoin.



# Token Patterns

**Target:** Examine the correlation between trends of various tokens. Do they demonstrate comparable patterns?

## Bitcoin's Trend Effect on Other Tokens' Trends

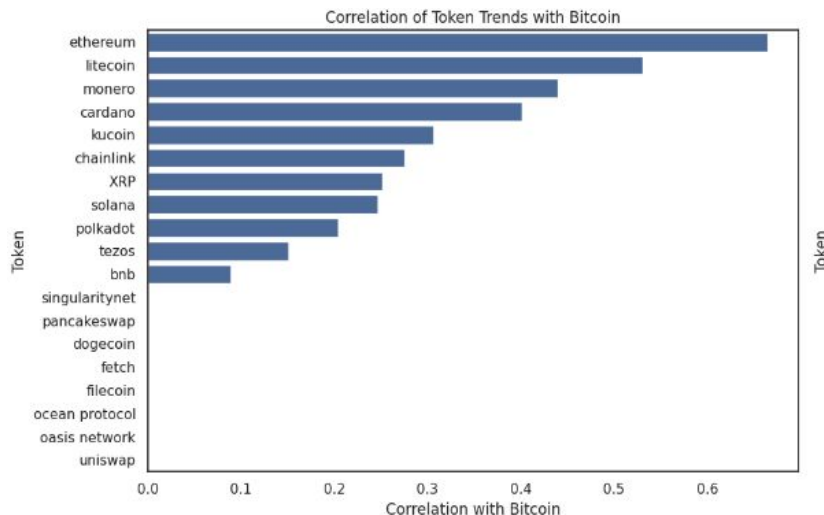
1. Ethereum: 0.66
2. Cardano: 0.40
3. Solana: 0.25
4. XRP: 0.25
5. Ethereum: 0.66
6. Litecoin: 0.53
7. Monero: 0.44
8. Other tokens show lower or negligible correlations.

### **Strong Positive Correlations:**

**Ethereum with Bitcoin (0.66):** Indicates that trends for **Ethereum** and **Bitcoin** often move in the same direction. This could suggest that market sentiment or interest in one major cryptocurrency might spill over or influence interest in the other.

### **Moderate to Mild Positive Correlations:**

**Bitcoin with Cardano, Litecoin, Monero,** (ranging from about 0.40 to 0.66): These correlations, while not extremely strong, are significant enough to suggest that trends in Bitcoin do have some influence on these other tokens.



# Token Patterns

**Target:** Examine the correlation between trends of various tokens. Do they demonstrate comparable patterns?

## Ethereum's Trend Effect on Other Tokens' Trends

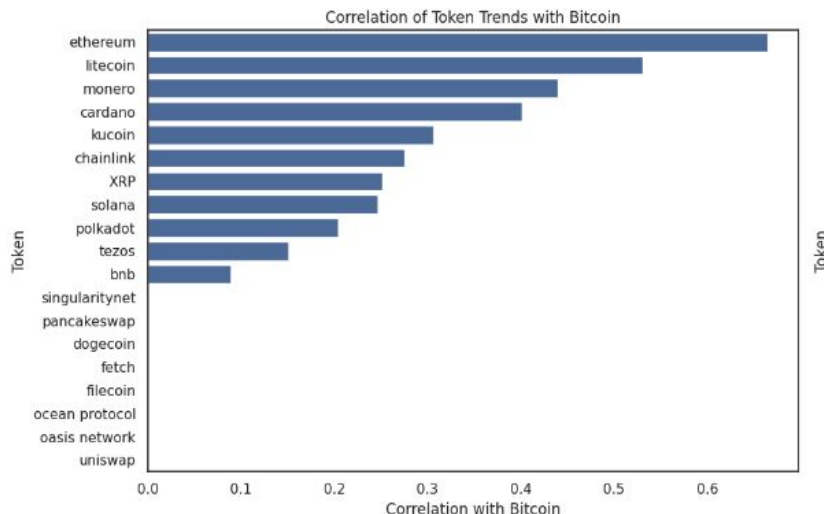
- Bitcoin: 0.66
- Cardano: 0.44
- Litecoin: 0.57
- Monero: 0.39
- Kucoin: 0.40
- Other tokens also show moderate to low correlations..

### **Strong Positive Correlations:**

**Ethereum with Litecoin (0.57):** Suggests a strong positive correlation relationship, where trends in Ethereum have a relatively strong impact on trends in Litecoin.

### **Moderate to Mild Positive Correlations:**

**Ethereum with Cardano and Kucoin** (about 0.44 and 0.40 respectively): Indicates a moderate relationship where Ethereum trends might predict similar movements in these tokens to some extent.



# Token Patterns

**Target:** Examine the correlation between trends of various tokens. Do they demonstrate comparable patterns?

## Bitcoin - Ethereum price [correlation](#)

The plots show the closing price trends for Bitcoin (in orange) and Ethereum (in blue) over time. Both cryptocurrencies display significant volatility and some periods of rapid price increases, as well as sharp declines

### Observations:

- Both **Bitcoin** and **Ethereum** show similar patterns in terms of major peaks and troughs, suggesting that their price movements might be correlated, particularly during major market events.
- **Bitcoin** generally exhibits **higher price** levels and more pronounced peaks compared to **Ethereum**, reflecting its higher market value and possibly greater market attention.



# Token Patterns

**Target:** Examine the correlation between trends of various tokens. Do they demonstrate comparable patterns?

## Bitcoin - Ethereum price [correlation](#)

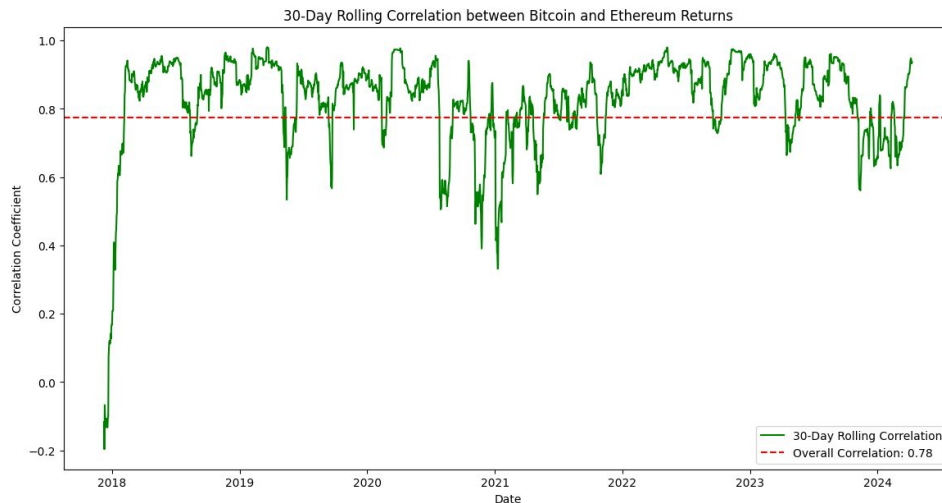
**Correlation Analysis** - The correlation coefficient between **Bitcoin price and Ethereum price** daily returns is approximately **0.775**, which indicates a **strong positive** relationship. This suggests that when Bitcoin's price moves, Ethereum's price tends to move in the same direction to a significant extent.

**Rolling Correlation** - The rolling correlation with a **30-day** window also shows strong positive correlations throughout the period, generally remaining high as shown in the green line on the plot. This correlation fluctuates over time, reflecting periods of stronger and weaker linkage between the two cryptocurrencies.

### Interpretation

The strong correlation and the patterns observed in both the price plots and the correlation analysis suggest that Bitcoin and Ethereum often react similarly to market conditions. Their price movements are not independent, likely due to:

- **Market Sentiment:** Moves in one can trigger similar sentiment in the other.
- **Investor Behavior:** Investors often trade multiple cryptocurrencies simultaneously.
- **External Market Factors:** Such as regulatory news or economic indicators, affecting cryptocurrencies broadly.



# Token Patterns

**Target:** Examine the correlation between trends of various tokens. Do they demonstrate comparable patterns?

## Legend:

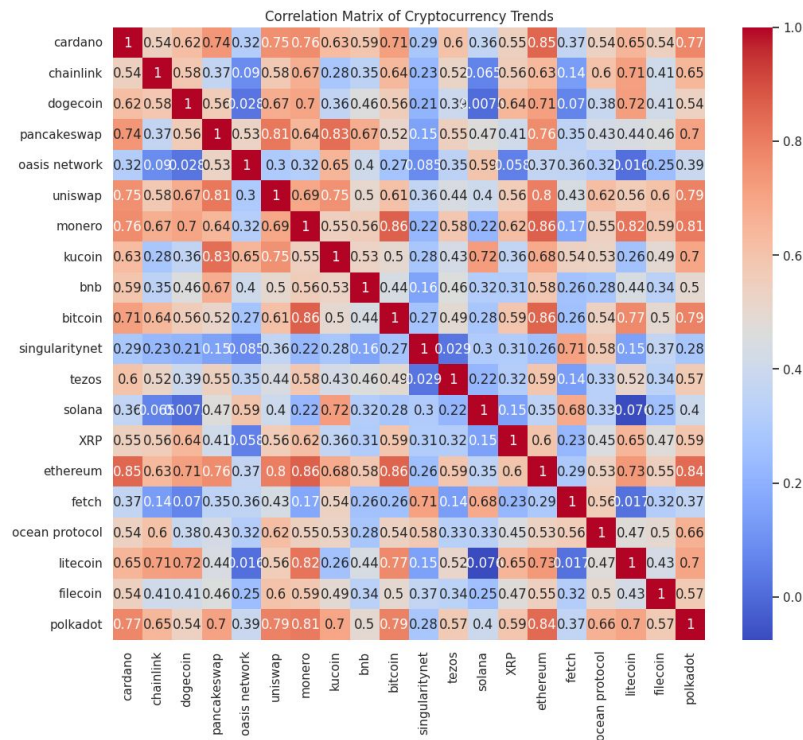
- 0.0 to 0.2: Very weak correlation
- 0.2 to 0.4: Weak correlation
- 0.4 to 0.6: Moderate correlation
- 0.6 to 0.8: Strong correlation
- 0.8 to 1.0: Very strong correlation

## Ocean Protocol [Correlations](#)

1. Polkadot: 0.660569
2. Uniswap: 0.620556
3. Chainlink: 0.603204
4. Singularitynet: 0.575918
5. Fetch: 0.559337
6. Monero: 0.545805
7. Cardano: 0.541248
8. Bitcoin: 0.538370
9. Ethereum: 0.533620
10. Kucoin: 0.528430

## Insights:

- Ocean Protocol has a strong positive correlation with **Polkadot** (0.660569) and **Uniswap** (0.620556), indicating that when the price of Polkadot&Uniswap increases, the price of Ocean Protocol tends to increase as well. This suggests a potential relationship or dependency between the two assets, possibly due to similar market trends, investor sentiment, or underlying technological connections.





# Token Patterns

**Target:** Examine the correlation between trends of various tokens. Do they demonstrate comparable patterns?

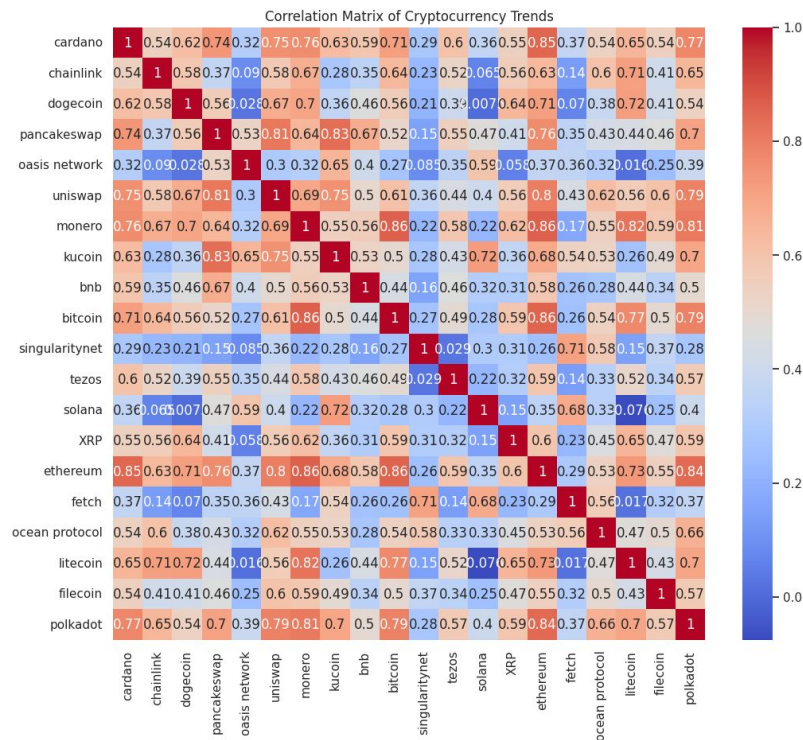
## Ocean Protocol [Correlations](#)

- Ocean Protocol also shows **moderate** positive correlations with **Chainlink** (0.603204), and **Singularitynet** (0.575918). These correlations suggest that these assets tend to move in the same direction as Ocean Protocol, although the relationship may not be as strong as with Polkadot.
- Ocean Protocol has **weaker** positive correlations with **Fetch** (0.559337), **Monero** (0.545805), **Cardano** (0.541248), **Bitcoin** (0.538370), **Ethereum** (0.533620), and **Kucoin** (0.528430). While these correlations are positive, they are not as strong as those mentioned earlier. Nonetheless, they still indicate some degree of co-movement between Ocean Protocol and these assets.

Overall, these correlation coefficients suggest that Ocean Protocol's price tends to move somewhat in tandem with several other cryptocurrencies, particularly **Polkadot**, **Uniswap**, **Chainlink**, and **Singularitynet**.

### Legend:

- 0.0 to 0.2: Very weak correlation
- 0.2 to 0.4: Weak correlation
- 0.4 to 0.6: Moderate correlation
- 0.6 to 0.8: Strong correlation
- 0.8 to 1.0: Very strong correlation



# Token Patterns

**Target:** Examine the correlation between trends of various tokens. Do they demonstrate comparable patterns?

**Conclusion:**

Cryptocurrencies exhibit distinct trend patterns, with some coins exerting influence on others, while others appear more isolated, less affected by the movements of their counterparts. This diversity in interconnectivity underscores the complex dynamics within the cryptocurrency market, where certain assets may demonstrate a stronger correlation with external factors, such as market sentiment or industry developments, while others maintain a relatively independent trajectory.

# Additional Data Sources

**Target:** Discover and incorporate an additional dataset to enrich your analysis. Rationalize your selection and extract fresh insights from it.

Included [transaction data](#) to enrich the analysis.

- **Estimated Transaction Value (USD)** - This metric provides insight into the total dollar value of all transactions processed on a blockchain within a specific timeframe. It serves as a significant indicator of the economic throughput of the network. By examining fluctuations in transaction values, we can gauge the overall economic activity and health of the cryptocurrency. For instance, a rising transaction value could suggest increased usage and acceptance, possibly indicating bullish market conditions.
- **Total Number of Transactions** - This indicates the total count of transactions processed. High transaction counts can imply a robust level of user engagement and network utility. It reflects the scalability and efficiency of a blockchain in handling loads, which can influence investor confidence and speculative interest in the asset.

Timestamp	TransactionVolumeUSD	TransactionCount
2017-01-01	242080686.702965	182941295
2017-01-08	364633034.66556	184567133.5
2017-01-15	267254361.021332	186928872
2017-01-22	217004066.792094	189143016
2017-01-29	189456740.849334	190780358
2017-02-05	245571889.794671	192427230.5
2017-02-12	237910348.964948	194781129.5
2017-02-19	191166681.302331	197118294.5
2017-02-26	302287144.975644	198804578
2017-03-05	304171803.640034	200695552.5
2017-03-12	279453928.67897	203112824
2017-03-19	450071699.95357	205403991
2017-03-26	283077152.107298	207142546
2017-04-02	272998431.394663	208733135
2017-04-09	379973024.382877	210910703.5
2017-04-16	274144862.579738	213070731
2017-04-23	263004962.489608	214675280
2017-04-30	408204586.607291	216376321.5
2017-05-07	508305667.598158	218814833.5
2017-05-14	585356981.079736	221443809.5
2017-05-21	719759417.082788	223319866
2017-05-28	922604708.651936	225300036.5
2017-06-04	834578349.437112	227916520.5

# Additional Data Sources

**Target:** Discover and incorporate an additional dataset to enrich your analysis. Rationalize your selection and extract fresh insights from it.

## Predictive Utility

- Both metrics are instrumental in understanding liquidity and market sentiment, which are key to predicting market trends. For example:
- **Correlation with Price Movements:** Significant increases in transaction values and counts might precede or coincide with upward price movements as they suggest higher usage and increased demand.
- **Market Sentiment Analysis:** By analyzing these metrics in conjunction with market sentiment data (e.g., Google Trend data), one can identify potential market reactions. For instance, if the transaction value and volume are high but the sentiment is negative, it could suggest a potential price correction.
- **Comparative Analysis:** Comparing these metrics across different cryptocurrencies can help identify which are gaining traction or facing issues, guiding investment decisions based on relative market performance.

Timestamp	TransactionVolumeUSD	TransactionCount
2017-01-01	242080686.702965	182941295
2017-01-08	364633034.66556	184567133.5
2017-01-15	267254361.021332	186928872
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2017-06-04	834578349.437112	227916520.5

# Machine Learning Model

**Target:** Develop a machine learning model to forecast the Google Trends data of a selected token. Choose your preferred token from the provided list of twenty.

**Predicting the Trend of [Bitcoin](#) with the following models:**

- **ARIMA (Autoregressive Integrated Moving Average)**

ARIMA is a traditional statistical model that uses differencing to render non-stationary time series data stationary, along with autoregressive and moving average components to capture the trends and noise in the data. It is widely used for forecasting where data show evidence of non-seasonal patterns over time.

- **SARIMA (Seasonal Autoregressive Integrated Moving Average)**

SARIMA extends the ARIMA model by incorporating seasonal elements, making it particularly effective for time series data with seasonal patterns. It adjusts for seasonality by incorporating seasonal differencing and seasonal autoregressive and moving average components, suited for data where seasonal influence is a significant driver of fluctuations.

- **Prophet**

Prophet is a forecasting tool designed by Facebook for handling time series data that exhibits strong seasonal effects and several seasons of historical data. It is robust to missing data and shifts in trend, and it can accommodate holiday effects, making it ideal for daily observations with irregular patterns over time.

- **LSTM (Long Short-Term Memory)**

LSTM is a type of recurrent neural network (RNN) that is capable of learning order dependence in sequence prediction problems. This makes it particularly suitable for time series forecasting where long-term patterns and relationships might need to be captured, and where the data may involve complex interactions that are not easily modeled by traditional statistical techniques.

# Machine Learning Model

**Target:** Develop a machine learning model to forecast the Google Trends data of a selected token. Choose your preferred token from the provided list of twenty.

**Predicting the Trend of [Bitcoin](#). Results:**

- **ARIMA Evaluation Metrics:**

MAE: 3.5333198579440164  
MSE: 28.466319795286324  
RMSE: 5.335383753328932

**Insights:**

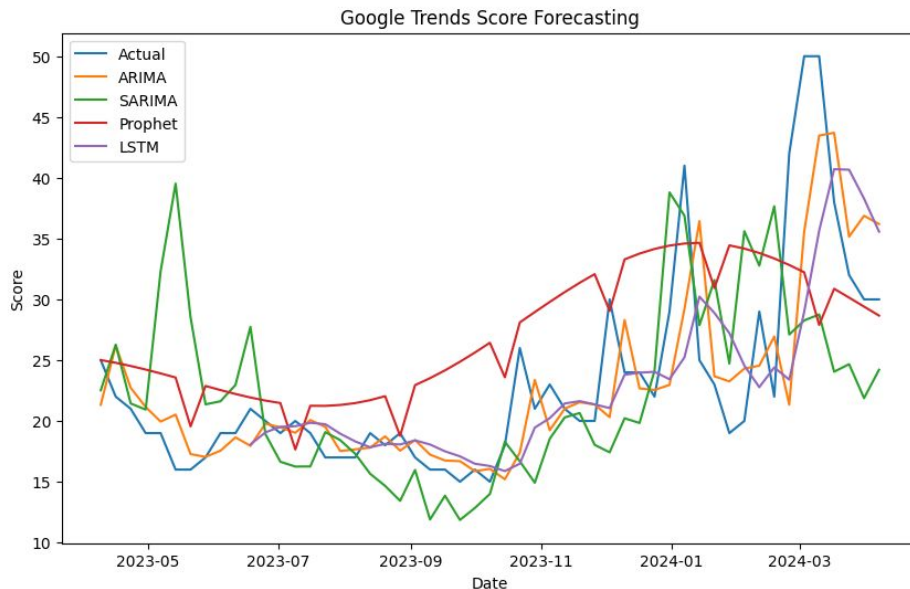
ARIMA shows the best performance among all models with the lowest values across all metrics. This suggests that ARIMA effectively captures the underlying trends and noise in the dataset without needing to account for complex or seasonal patterns.

- **SARIMA Evaluation Metrics:**

MAE: 6.077230779590015  
MSE: 69.83912078009357  
RMSE: 8.356980362552827

**Insights:**

SARIMA, designed to handle seasonal fluctuations in addition to non-seasonal components, shows moderate error values. It performs worse than ARIMA in this case, indicating that the additional complexity to model seasonality might not be necessary or that the seasonal patterns are not as prominent or as well-aligned with the model's configuration.



# Machine Learning Model

**Target:** Develop a machine learning model to forecast the Google Trends data of a selected token. Choose your preferred token from the provided list of twenty.

**Predicting the Trend of [Bitcoin](#). Results:**

- **Prophet Evaluation Metrics:**

MAE: 6.514129168564586

MSE: 63.85613285309071

RMSE: 7.991003244467538

**Insights:**

Prophet performs comparably to SARIMA but not as well as ARIMA. This suggests that while Prophet is robust for handling missing data and making adjustments for holiday effects and sudden changes in trend, it may not offer advantages in this specific dataset where such features are not dominant or where simpler models suffice.

**LSTM Evaluation Metrics:**

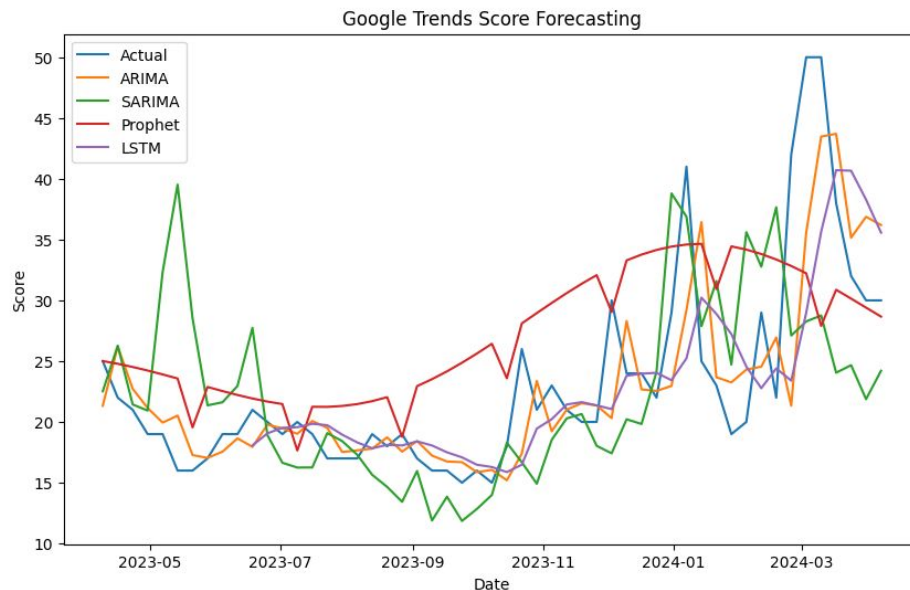
MAE: 22.874258780664256

MSE: 565.4255537575577

RMSE: 23.778678553644603

**Insights:**

LSTM displays significantly higher error metrics compared to the other models. LSTMs are powerful for datasets with complex and long-term dependencies, but they require careful tuning and sufficient training data to perform effectively.





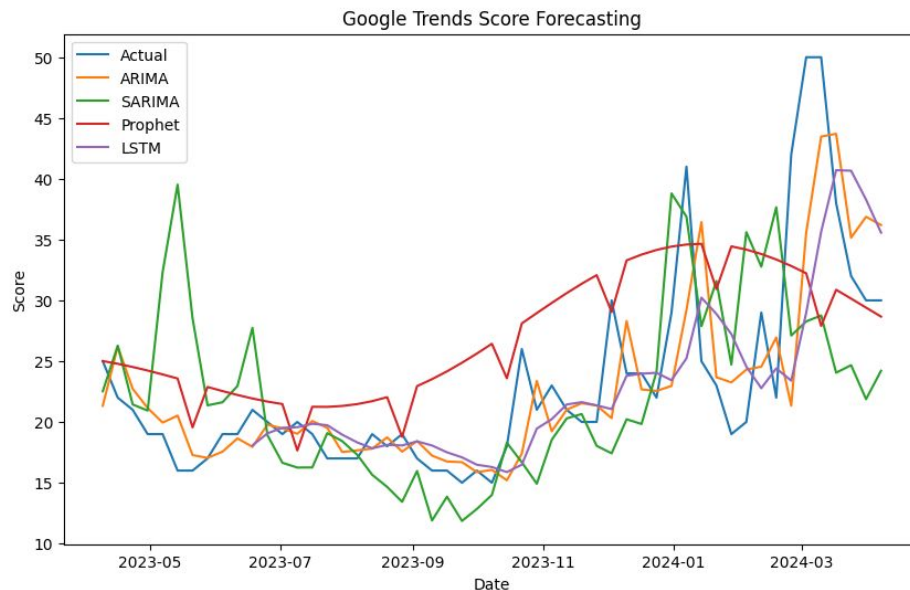
# Machine Learning Model

**Target:** Develop a machine learning model to forecast the Google Trends data of a selected token. Choose your preferred token from the provided list of twenty.

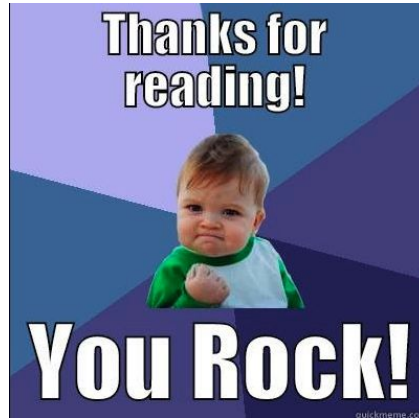
**Predicting the Trend of [Bitcoin](#). Results:**

## Conclusion:

The comparison suggests that **ARIMA** provides the **most accurate and efficient predictions** for this dataset, hinting at a scenario where simplicity and focus on trend and noise without seasonal adjustments yield the best results. The performance of SARIMA and Prophet implies that additional complexity or the modeling of seasonal and irregular components does not necessarily lead to better performance. LSTM's underperformance highlights challenges with neural networks in time series forecasting where data characteristics and model fit issues can significantly impact performance.







For the code and additional resources, head over to the [GitHub](#) repository. If you have any uncertainties or questions, please reach out via Discord (white\_rider\_) or [Twitter](#)!