

Descriptive Analysis of the Cryptocurrency Market Using Power BI

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1 Introduction

In recent years, the cryptocurrency market has experienced rapid growth and increasing volatility, making data-driven analysis an essential tool for investors, analysts, and decision-makers. Cryptocurrencies such as Bitcoin, Ethereum, and other digital assets generate large volumes of time-series financial data, including prices, trading volumes, and market capitalization. Analyzing this data helps in understanding market behavior, identifying trends, assessing risk, and supporting investment decisions.

The objective of this project is to perform a descriptive analysis of the cryptocurrency market using Microsoft Power BI. The analysis focuses on historical price data, trading volume, market capitalization, volatility, and monthly returns of multiple cryptocurrencies. Additionally, external market sentiment information, specifically the Crypto Fear & Greed Index, is integrated to provide a broader perspective on investor psychology and market conditions.

This project follows a structured workflow consisting of data preparation and cleaning, descriptive statistical analysis, interactive dashboard design, and the implementation of analytical calculations using DAX (Data Analysis Expressions). The final outcome is a multi-page interactive dashboard that enables users to explore market trends, compare cryptocurrencies, and extract meaningful insights from the data.

All datasets, Power BI dashboard files, and the complete project documentation are publicly available in the following GitHub repository:

<https://github.com/Mahyar-mhn/crypto-market-analysis-powerbi>

The repository ensures transparency, reproducibility, and ease of access for further exploration or future extensions of the project.

2 Task I: Dataset Preparation and Cleaning

Data preparation is a critical step in any data analysis project, as incorrect or inconsistent data can lead to errors during processing and misleading analytical results. In this project, the dataset was prepared and cleaned using the *Power Query Editor* in Microsoft Power BI. The cleaning process followed the requirements specified in Task I and ensured that the data was fully compatible with subsequent analysis and visualization stages.

2.1 Data Source

The cryptocurrency dataset was downloaded from the provided source and imported into Power BI using the **Home** → **Get Data** option. The dataset contains historical informa-

tion for multiple cryptocurrencies, including price data (open, high, low, close), trading volume, and market capitalization across different dates.

2.2 Removal of Null Values

After importing the dataset, the first cleaning step involved identifying and removing null or missing values. This was performed in the Power Query Editor by selecting all columns and using the **Remove Rows** → **Remove Blank Rows** option. Additionally, column-level filters were applied to remove any remaining null entries. This step was essential to prevent calculation errors and visualization issues during data loading and analysis.

2.3 Data Type Conversion

Several columns in the dataset were initially stored as text values due to formatting issues such as commas in numerical fields. Each column was converted to its appropriate data type to ensure correct mathematical operations and aggregations. Specifically, price-related columns (**open**, **high**, **low**, **close**) were converted to **Decimal Number**, while **volume** and **market cap** were converted to **Whole Number**. Before conversion, comma separators were removed using the **Replace Values** feature in Power Query.

2.4 Date and Symbol Formatting

The **date** column was originally stored as text and required conversion to a valid date format. Power BI's **Detect Data Type** and **Change Type Using Locale** features were used to correctly parse the date values into a standard **Date** format. This ensured accurate time-series analysis and enabled monthly aggregations in later stages.

Cryptocurrency symbols and names were cleaned to maintain consistency across the dataset. Text formatting operations such as **Trim**, **Clean**, and capitalization were applied to remove extra spaces and ensure uniform naming conventions. This step was necessary to guarantee correct grouping and comparison of cryptocurrencies in visualizations.

2.5 Column Renaming and Standardization

To improve readability and prevent issues in DAX calculations, column names were standardized using lowercase naming conventions without spaces or special characters. For example, **Market Cap** was renamed to **marketcap**, and **Currency** was renamed to **symbol**. This standardization simplifies formula writing and enhances consistency throughout the Power BI model.

2.6 Final Data Validation

After completing all cleaning steps, the dataset was reviewed to confirm that all columns had correct data types, no null values remained, and all naming conventions were consistent. The cleaned dataset was then loaded into Power BI using the **Close & Apply** option. Completing these preparation steps ensured that the data could be safely loaded without errors and provided a reliable foundation for descriptive analysis and dashboard development in subsequent tasks.

3 Task II: Descriptive Data Analysis

3.1 Price Trend Analysis Over Time

To analyze the evolution of cryptocurrency prices over time, a line chart was created in Power BI using the closing price (**close**) and date information. The chart visualizes the historical price trends of multiple cryptocurrencies simultaneously, allowing for a direct comparison of their market behavior across different years.

The line chart uses **Year** as the time dimension on the x-axis and the aggregated closing price on the y-axis, with each line representing a different cryptocurrency. This visualization highlights both long-term growth patterns and periods of significant volatility in the market.

As shown in Figure 1, Bitcoin exhibits a substantially higher price level compared to other cryptocurrencies throughout the observed period. A sharp increase is visible between 2016 and 2018, indicating a major bullish phase in the cryptocurrency market, followed by a slight decline in 2019. Other cryptocurrencies such as Ethereum and Bitcoin Cash follow similar trends but at significantly lower price levels, reflecting their comparatively smaller market valuations.

This analysis demonstrates the highly volatile nature of the cryptocurrency market and emphasizes the dominance of Bitcoin in terms of price magnitude. The line chart provides a clear temporal overview that serves as a foundation for further comparative and risk-based analyses in subsequent sections.

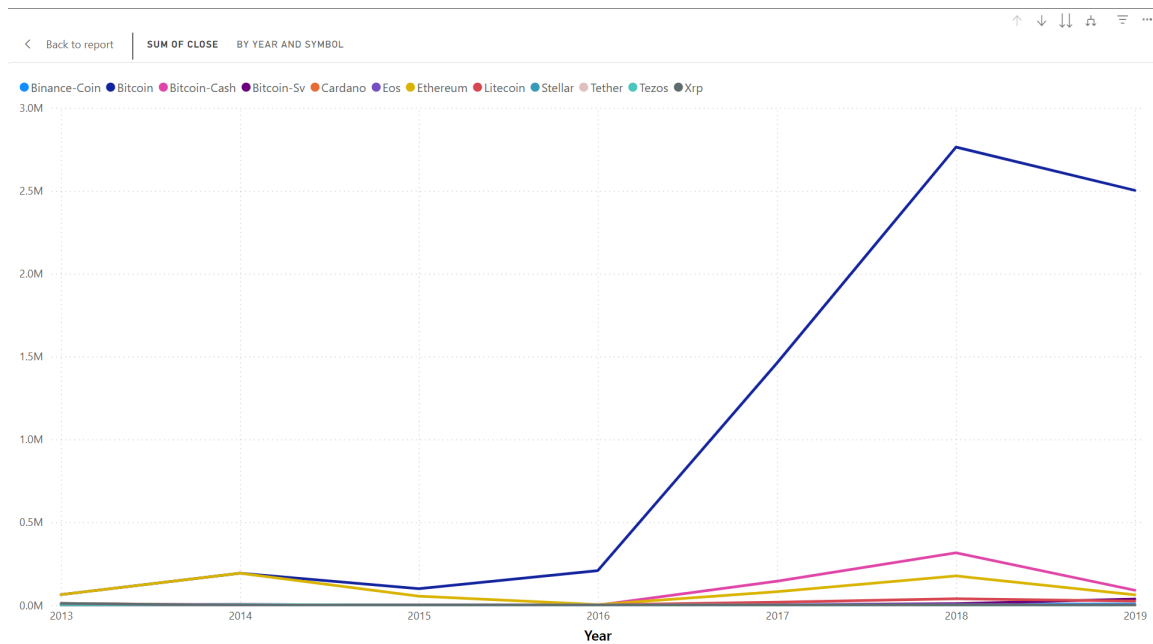


Figure 1: Trend of closing prices for selected cryptocurrencies over time

3.2 Average Price Comparison of Cryptocurrencies

To compare the average price levels of different cryptocurrencies, a clustered column chart was created in Power BI using the average of the closing price (`close`) for each cryptocurrency. The x-axis represents individual cryptocurrencies, while the y-axis shows their corresponding average closing prices over the entire observation period.

As illustrated in Figure 2, Bitcoin has a significantly higher average closing price compared to all other cryptocurrencies in the dataset. Ethereum and Bitcoin Cash follow at a considerable distance, while the remaining cryptocurrencies such as Litecoin, Binance Coin, XRP, Tezos, and Cardano exhibit substantially lower average price levels.

This large disparity highlights the dominance of Bitcoin in terms of price magnitude and reflects its established position in the cryptocurrency market. The comparison also demonstrates how most alternative cryptocurrencies operate within much lower price ranges, emphasizing differences in market maturity, adoption, and capitalization among digital assets.

The column chart provides a clear and intuitive comparison that supports further analysis of market structure and assists in identifying major and minor players within the cryptocurrency ecosystem.

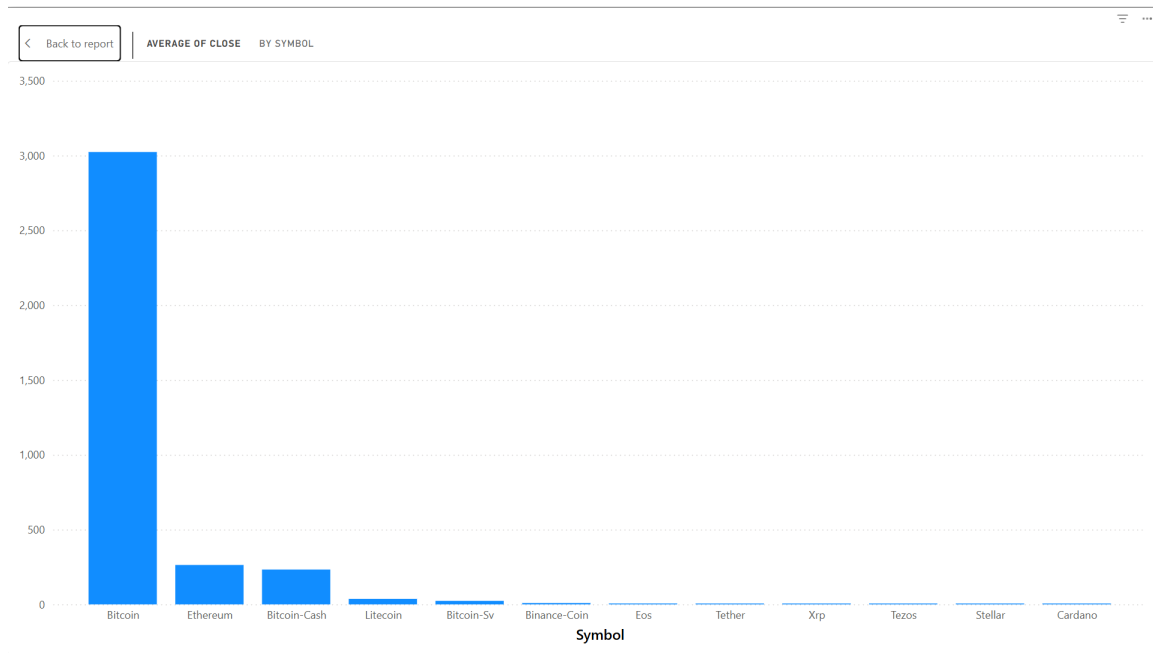


Figure 2: Comparison of average closing prices across cryptocurrencies

3.3 Volatility Analysis

To evaluate the price volatility of each cryptocurrency, a volatility metric was calculated based on the difference between the highest and lowest prices over time. This metric reflects the magnitude of price fluctuations and serves as an indicator of market risk. The volatility values were then aggregated and visualized using a horizontal bar chart in Power BI.

Figure 3 presents the sum of volatility values for each cryptocurrency. Bitcoin exhibits the highest overall volatility by a significant margin, indicating substantial price fluctuations throughout the analyzed period. Bitcoin Cash and Ethereum also demonstrate notable volatility, although at considerably lower levels compared to Bitcoin. Other cryptocurrencies such as Litecoin, Binance Coin, XRP, and Tezos show relatively low volatility, suggesting more stable price behavior during the same timeframe.

The results highlight that cryptocurrencies with higher price levels and market activity tend to experience larger absolute price movements. From an investment perspective, higher volatility implies higher risk but may also offer greater opportunities for short-term trading strategies. This analysis provides important insights into the risk characteristics of different cryptocurrencies and complements the price trend analysis presented earlier.

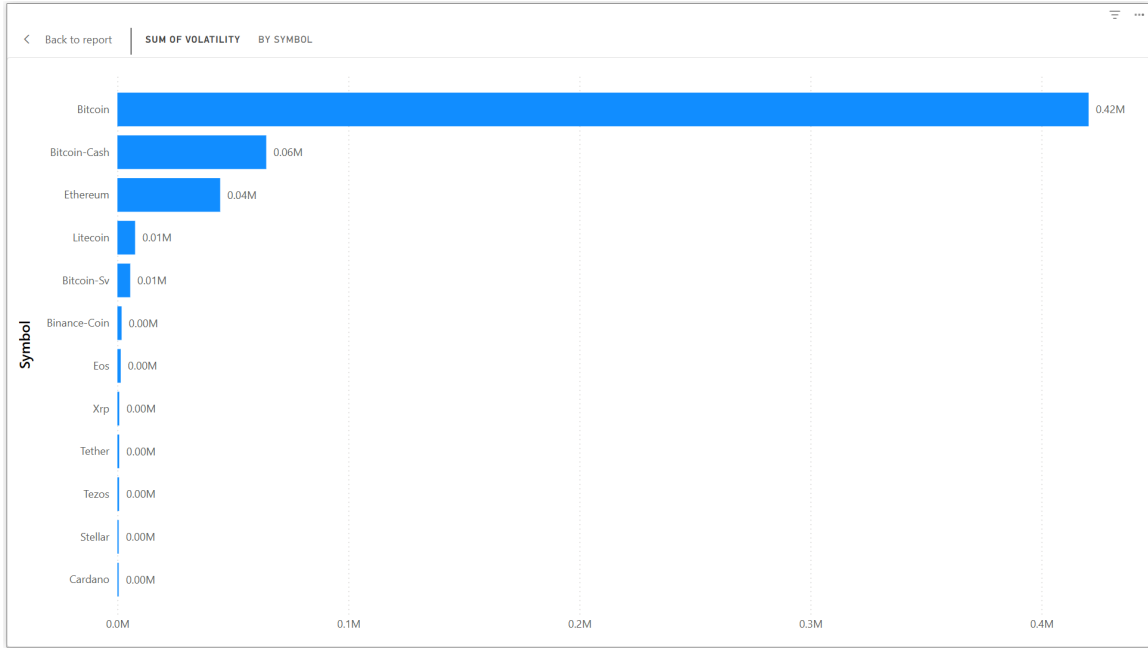


Figure 3: Comparison of price volatility across cryptocurrencies

3.4 Relationship Between Trading Volume and Closing Price

To examine the relationship between trading activity and price levels, a scatter plot was created in Power BI using trading volume and closing price data. In this visualization, the x-axis represents the total trading volume, while the y-axis corresponds to the aggregated closing price. Each data point represents a cryptocurrency, allowing for comparison across different market sizes and activity levels.

As illustrated in Figure 4, Bitcoin is positioned in the upper-right region of the chart, indicating both a high trading volume and a high closing price. This suggests a strong association between market activity and price magnitude for major cryptocurrencies. Ethereum and Tether also display relatively high trading volumes, though at lower price levels compared to Bitcoin.

Smaller cryptocurrencies such as Litecoin, EOS, Cardano, and Tezos are clustered near the lower-left region of the chart, reflecting lower trading volumes and lower price levels. The overall distribution of points indicates that cryptocurrencies with higher market participation tend to exhibit higher prices, although the relationship is not strictly linear.

This scatter plot provides valuable insights into market dynamics by highlighting how liquidity and investor activity relate to asset pricing. Such analysis is useful for identifying dominant cryptocurrencies and understanding the role of trading volume in price formation.

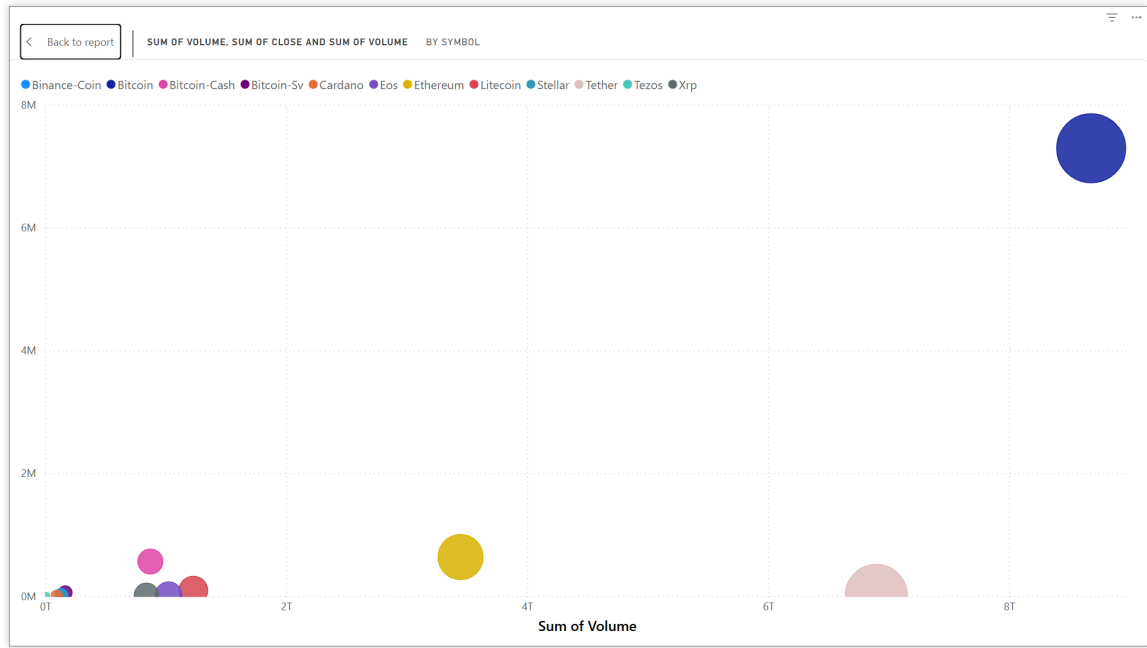


Figure 4: Relationship between trading volume and closing price of cryptocurrencies

3.5 Maximum and Minimum Price Analysis

To identify the extreme price levels observed during the study period, Key Performance Indicator (KPI) cards were used in Power BI to display the maximum and minimum recorded closing prices. These indicators provide a concise summary of the price range and highlight the most significant market peaks and troughs.

As shown in Figure 5, the maximum closing price observed in the dataset is approximately 19,500, which corresponds to the peak value reached by Bitcoin during the analyzed period. This value reflects periods of intense market optimism and strong investor demand. In contrast, the minimum closing price is recorded as zero, indicating either very low-priced assets or initial trading periods for certain cryptocurrencies within the dataset.

These KPIs offer a quick overview of the overall price dispersion in the cryptocurrency market and complement the detailed trend and volatility analyses presented earlier. From an analytical perspective, understanding the range between maximum and minimum prices is essential for assessing market risk, identifying extreme events, and contextualizing price movements across different digital assets.



Figure 5: Maximum and minimum closing prices observed in the dataset

3.6 Monthly Return Analysis

To analyze the percentage change in cryptocurrency prices over time, the monthly return metric was calculated using DAX in Power BI. Monthly return is defined as the relative change in the closing price compared to the previous month and provides insight into short-term performance and market momentum. This calculation enables the identification of periods with rapid growth or sharp declines.

Figure 6 presents the monthly returns for individual cryptocurrencies over time. The visualization highlights substantial fluctuations, particularly for certain assets such as Bitcoin Cash, which exhibits extreme positive spikes in specific months. These sharp variations indicate periods of heightened speculation or abrupt market reactions. In contrast, major cryptocurrencies such as Bitcoin and Ethereum display more moderate but persistent fluctuations, reflecting comparatively higher market maturity and liquidity.

To better understand the overall market behavior, an aggregated monthly return trend is shown in Figure 7. This chart reveals a declining trend in monthly returns over time, indicating reduced growth rates following early periods of rapid expansion. Negative values observed in later months suggest periods of market correction and increased uncertainty.

The monthly return analysis complements the price trend and volatility evaluations by emphasizing the dynamic nature of cryptocurrency markets. It provides a clear representation of risk and reward patterns, supporting more informed investment and risk management decisions.

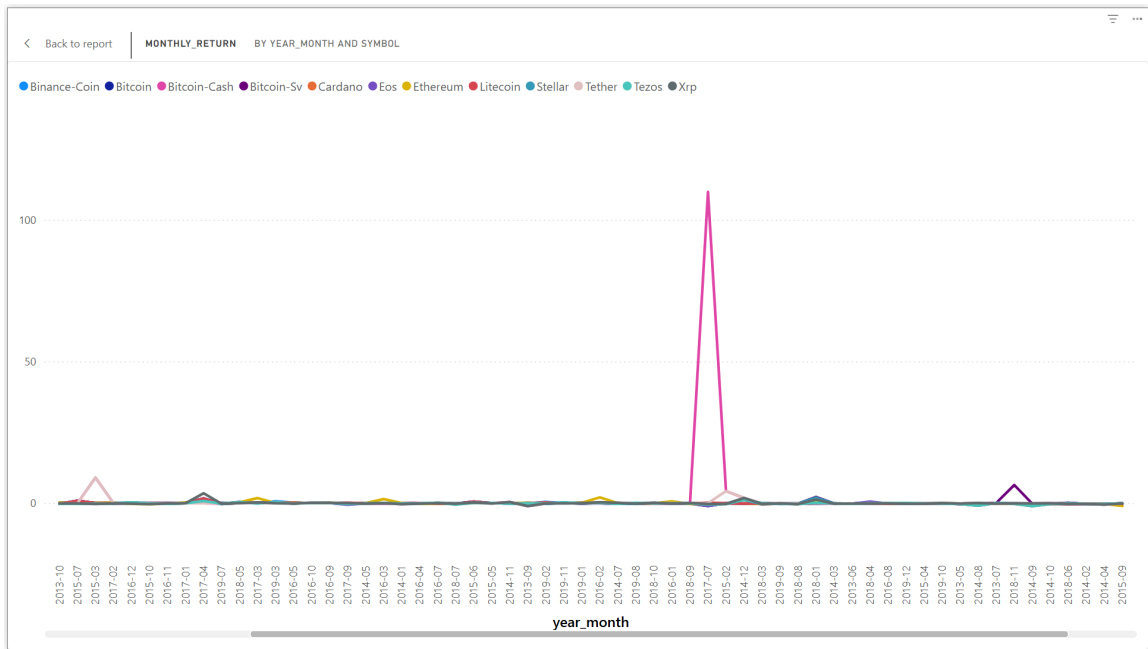


Figure 6: Monthly return trends for individual cryptocurrencies

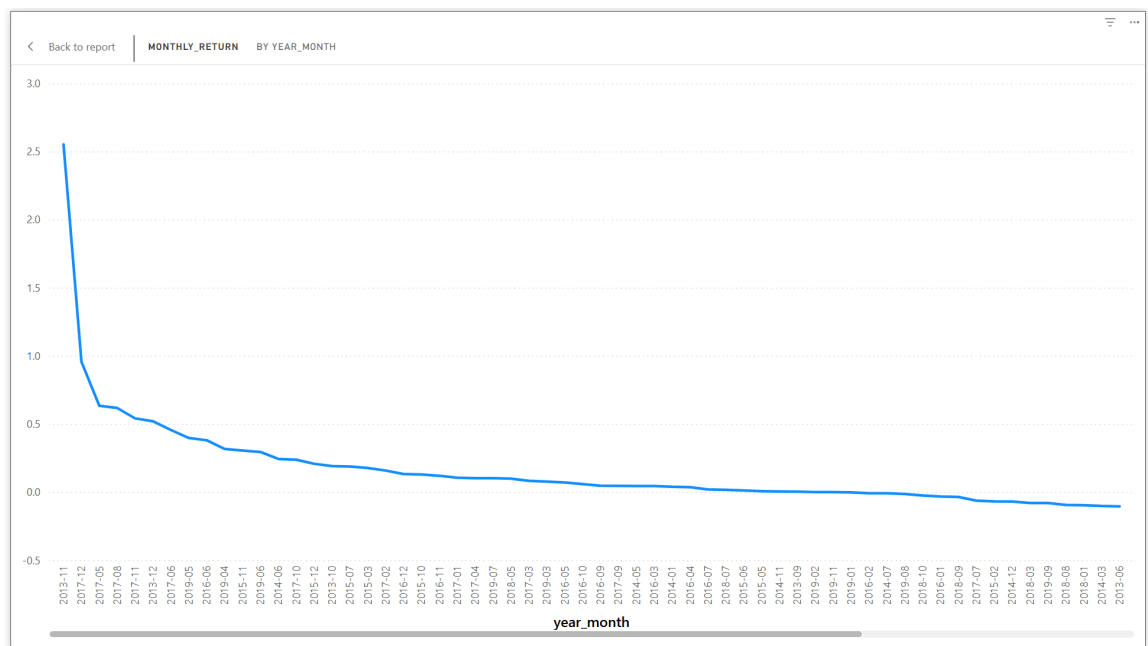


Figure 7: Overall monthly return trend across the cryptocurrency market

4 Task III: Dashboard Design and Visualization

4.1 Overview Dashboard

The Overview dashboard serves as the main entry point for the cryptocurrency market analysis and provides a high-level summary of key market indicators. This page was

designed to give users a quick understanding of overall market conditions before exploring more detailed analyses in subsequent dashboard pages.

As shown in Figure 8, the dashboard includes key performance indicator (KPI) cards displaying the total market capitalization and the average trading volume across all cryptocurrencies in the dataset. These KPIs offer an immediate snapshot of the market size and liquidity, which are essential metrics for assessing overall market strength and investor activity.

In addition to the KPIs, a horizontal bar chart visualizing the monthly return by cryptocurrency is included. This chart allows users to quickly identify top-performing and underperforming assets within the selected period. Positive and negative returns are clearly distinguishable, enabling an intuitive comparison of recent market performance across different cryptocurrencies.

The Overview dashboard is designed to be concise, informative, and visually accessible. By combining high-level indicators with comparative performance metrics, this page supports rapid decision-making and provides context for deeper trend, comparison, and insight analyses presented in the remaining dashboard pages.

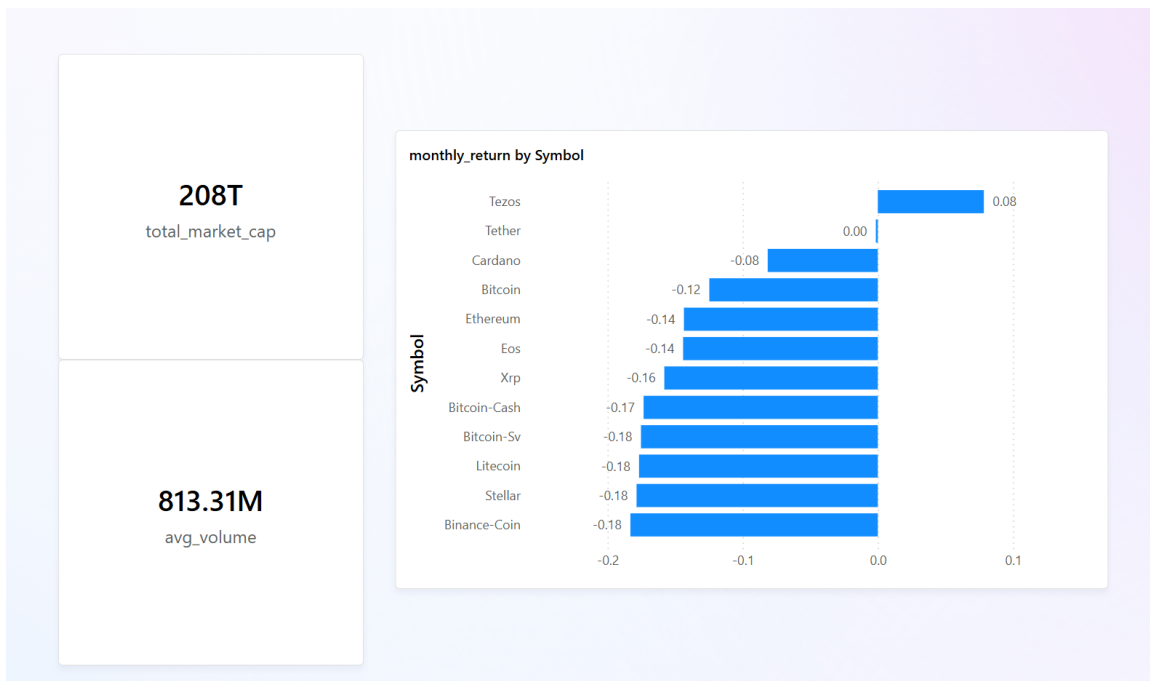


Figure 8: Overview dashboard presenting key market indicators and monthly return comparison

4.2 Price Trends Dashboard

The Price Trends dashboard is designed to provide a detailed temporal analysis of cryptocurrency price movements and associated risk indicators. This page focuses on under-

standing how prices, returns, and volatility evolve over time and how these patterns differ across cryptocurrencies.

As illustrated in Figure 9, the dashboard includes a line chart showing the monthly evolution of closing prices for selected cryptocurrencies. This visualization enables users to observe seasonal patterns, long-term growth trends, and short-term fluctuations. Bitcoin consistently exhibits higher price levels compared to other assets, while alternative cryptocurrencies display lower but more variable price movements.

In addition, a line chart presenting the annual monthly return trend is included to highlight changes in market momentum over time. This chart reveals periods of strong positive returns as well as market downturns, indicating phases of expansion and correction in the cryptocurrency market.

To complement the price and return analyses, a horizontal bar chart summarizing total volatility by cryptocurrency is provided. This visual emphasizes differences in price fluctuation intensity across assets, with Bitcoin showing the highest overall volatility. The combination of these visuals allows users to jointly assess price performance and risk characteristics.

Overall, the Price Trends dashboard offers a comprehensive view of temporal market behavior and serves as a critical tool for understanding both growth dynamics and volatility patterns before performing deeper comparative or insight-driven analyses.

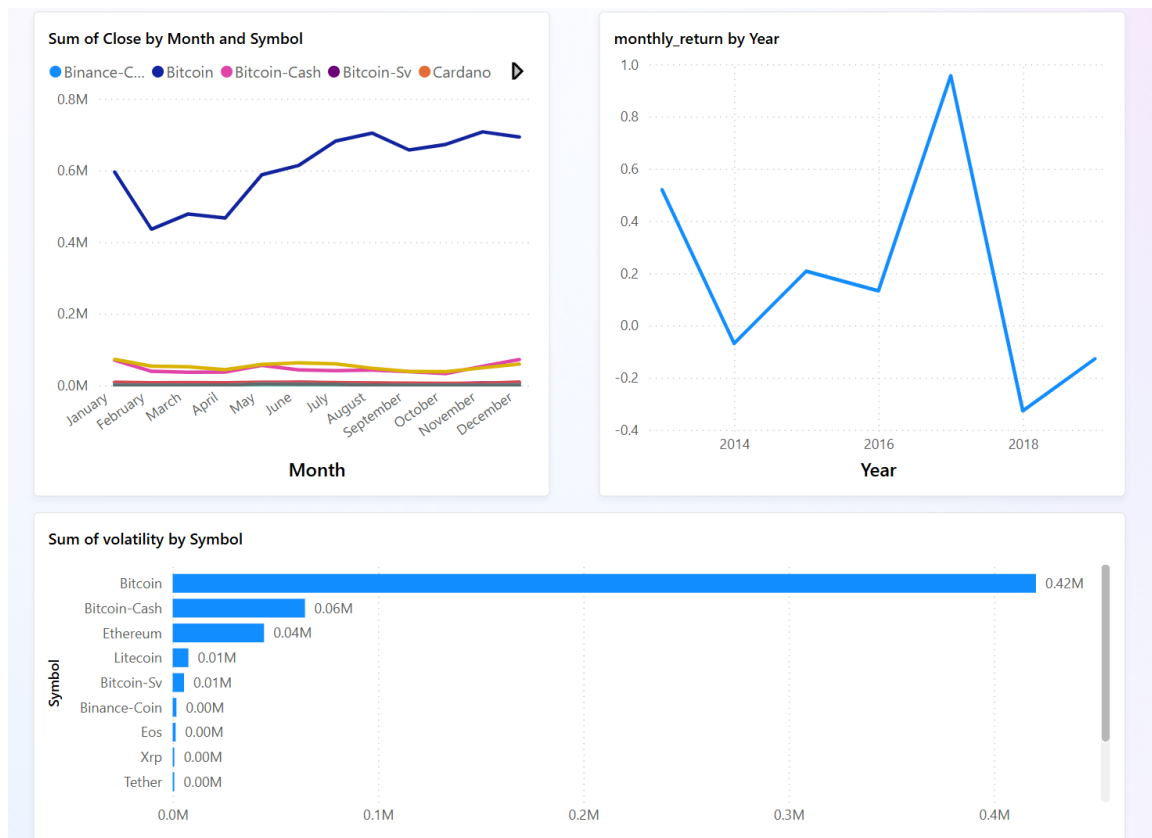


Figure 9: Price trends dashboard showing closing price evolution, monthly return trends, and volatility analysis

4.3 Comparison Dashboard

The Comparison dashboard is designed to enable a side-by-side evaluation of cryptocurrencies based on key financial metrics, including trading volume, average closing price, and market capitalization. This page allows users to identify relative differences between digital assets and assess their market position from multiple perspectives.

As shown in Figure 10, three clustered column charts are presented. The first chart compares the total trading volume by cryptocurrency, highlighting market liquidity and investor activity. Bitcoin and Ethereum dominate trading volume, indicating higher levels of market participation compared to other cryptocurrencies such as Cardano, Tezos, and Stellar.

The second chart presents the average closing price for each cryptocurrency. Bitcoin exhibits a substantially higher average price than all other assets, while Ethereum and Bitcoin Cash follow at significantly lower levels. Most alternative cryptocurrencies operate within comparatively small price ranges, reflecting differences in adoption and market maturity.

The third chart compares total market capitalization across cryptocurrencies. Bitcoin

clearly dominates the market in terms of capitalization, followed by Ethereum and XRP. This visualization emphasizes the concentration of market value among a small number of leading cryptocurrencies.

By integrating volume, price, and market capitalization comparisons into a single dashboard, this page provides a comprehensive overview of relative market strength and scale. The Comparison dashboard supports informed analysis by enabling users to quickly identify major market players and distinguish them from lower-cap assets.

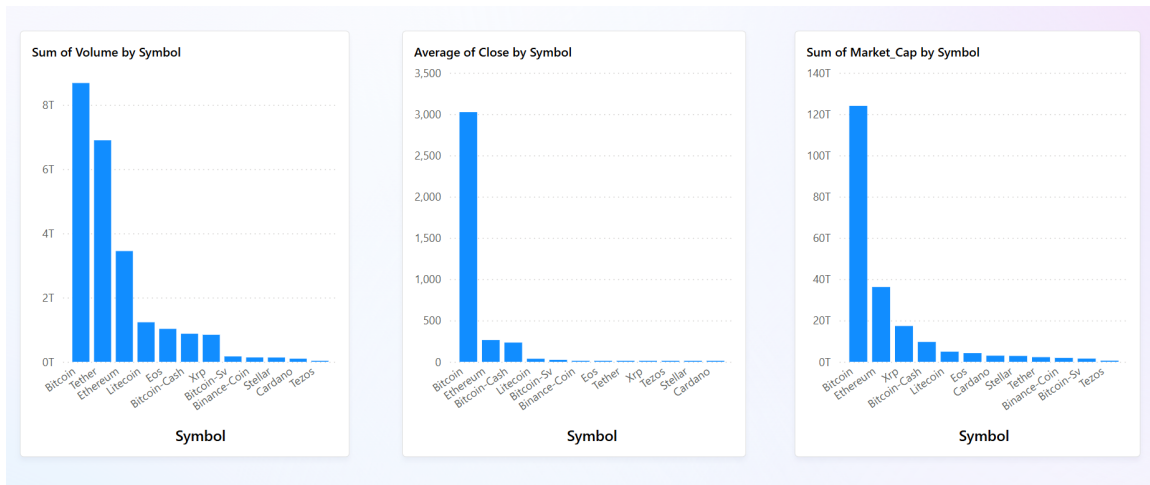


Figure 10: Comparison dashboard showing trading volume, average closing price, and market capitalization by cryptocurrency

4.4 Insights Dashboard

The Insights dashboard is designed to provide advanced analytical perspectives by combining multiple variables and visual techniques. This page focuses on uncovering deeper relationships within the cryptocurrency market, particularly the interaction between trading volume, price levels, and temporal trends.

As shown in Figure 11, a scatter plot is used to analyze the relationship between trading volume and closing price across cryptocurrencies. The visualization highlights that Bitcoin occupies a distinct position with both the highest trading volume and the highest closing price, reinforcing its dominant role in the market. Other cryptocurrencies are clustered closer to the origin, indicating lower liquidity and price levels. This pattern suggests a positive association between market activity and price magnitude for major assets.

In addition, a combined column and line chart is employed to compare trading volume and average closing price over time. The bar component represents trading volume by year and cryptocurrency, while the line component illustrates the corresponding average closing price. This dual-axis visualization reveals periods where increases in trading volume

coincide with rising prices, particularly during market expansion phases. Conversely, it also highlights periods of declining prices despite high trading activity, reflecting market corrections and increased volatility.

By integrating multiple analytical views into a single dashboard, the Insights page supports a more comprehensive understanding of market behavior. It enables users to identify dominant cryptocurrencies, assess liquidity–price interactions, and observe how market dynamics evolve over time. This dashboard complements the descriptive and comparative analyses presented earlier by providing actionable insights into cryptocurrency market structure and behavior.

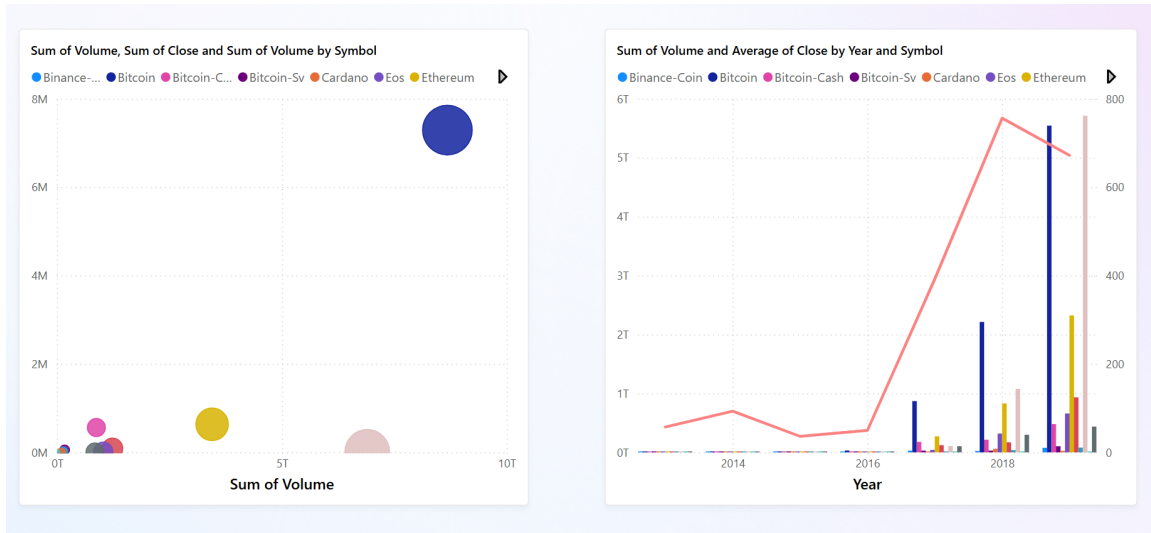


Figure 11: Insights dashboard illustrating volume–price relationships and combined temporal analysis

5 Task IV: DAX Calculations and Advanced Features

In this task, several analytical calculations and advanced visualization features were implemented using DAX (Data Analysis Expressions) and Power BI formatting tools. These calculations enhance the analytical depth of the dashboard and enable more meaningful interpretation of cryptocurrency market behavior.

5.1 Volatility Calculation

Price volatility was calculated to measure the degree of price fluctuation for each cryptocurrency. Volatility was defined as the relative difference between the highest and lowest prices compared to the opening price. This calculation was implemented as a calculated column in Power BI to allow row-level analysis and aggregation in visualizations.

The DAX expression used for volatility calculation is shown below:

$$\text{Volatility} = \frac{\text{High} - \text{Low}}{\text{Open}} \quad (1)$$

This metric was later aggregated and visualized using bar charts to compare the risk levels of different cryptocurrencies.

5.2 Average Closing Price Calculation

To summarize price behavior across the dataset, the average closing price was computed using a DAX measure. This measure enabled consistent aggregation of closing prices across different time periods and cryptocurrencies.

The following DAX expression was used:

$$\text{Avg_Close} = \text{AVERAGE}(\text{Close}) \quad (2)$$

This measure was primarily used in comparison dashboards to evaluate relative price levels among cryptocurrencies.

5.3 Monthly Return Calculation

Monthly return was calculated to assess the percentage change in price from one month to the next. This metric provides insight into short-term performance, growth trends, and market momentum. The calculation was implemented using DAX measures that reference previous-period values.

Monthly return is defined as:

$$\text{Monthly Return} = \frac{\text{Close}_t - \text{Close}_{t-1}}{\text{Close}_{t-1}} \quad (3)$$

The resulting monthly return values were visualized using line charts, allowing the identification of periods with strong growth, sharp declines, and increased volatility across different cryptocurrencies.

5.4 Conditional Formatting

To improve interpretability and align the dashboard with common financial analysis practices, conditional formatting was applied to selected visuals. Positive values, such as positive monthly returns, were highlighted using green color schemes, while negative values were displayed in red. This visual encoding enables users to quickly distinguish gains from losses and supports faster decision-making.

Conditional formatting was applied using rule-based color settings in Power BI, ensuring consistent representation across tables and charts.

5.5 Integration of Crypto Fear & Greed Index

To incorporate market sentiment into the analysis, the Crypto Fear & Greed Index was retrieved from an external web source using Power BI's **Get Data** → **Web** functionality. The index data was imported in JSON format, transformed, and converted into a structured table.

The Fear & Greed Index provides an additional layer of analysis by reflecting investor sentiment and emotional behavior in the cryptocurrency market. This external indicator was integrated into the dashboard using cards and trend visualizations, allowing users to relate sentiment changes to price movements and trading activity.

The integration of DAX-based calculations, conditional formatting, and external sentiment data significantly enhances the analytical capability of the dashboard and supports more comprehensive market insights.

6 Results and Analytical Insights

This section summarizes the key findings derived from the descriptive analysis and dashboard visualizations. By examining price trends, volatility, trading volume, market capitalization, and sentiment indicators, several important insights about the cryptocurrency market were identified.

6.1 Top Gaining Cryptocurrencies

The analysis of price trends and monthly returns indicates that Bitcoin remains the dominant cryptocurrency in terms of price magnitude and overall market influence. Periods of strong positive monthly returns are observed primarily during market expansion phases, particularly between 2016 and 2018. Certain alternative cryptocurrencies, such as Bitcoin Cash and Ethereum, exhibit occasional sharp positive spikes in monthly returns, suggesting higher sensitivity to speculative market movements.

However, these gains are often accompanied by increased volatility, highlighting the trade-off between potential returns and risk. Overall, major cryptocurrencies demonstrate more stable growth patterns compared to smaller assets, which tend to experience abrupt and less predictable price changes.

6.2 High-Risk and High-Volatility Assets

Volatility analysis reveals that Bitcoin exhibits the highest absolute volatility due to its large price scale and sustained market activity. Bitcoin Cash and Ethereum also show notable volatility, indicating higher risk exposure relative to other cryptocurrencies. In contrast, assets such as Tether, Tezos, and Stellar display relatively low volatility, reflecting more stable price behavior during the analyzed period.

From a risk management perspective, cryptocurrencies with high volatility may offer greater short-term trading opportunities but also expose investors to significant downside risk. Lower-volatility assets may be more suitable for conservative strategies or portfolio diversification.

6.3 Relationship Between Trading Volume and Price

The scatter plot analysis demonstrates a positive relationship between trading volume and closing price for major cryptocurrencies. Bitcoin clearly occupies the upper-right region of the volume–price space, indicating both high liquidity and high price levels. Ethereum and Tether also show substantial trading volumes, although at lower price ranges compared to Bitcoin.

Smaller cryptocurrencies cluster near lower volume and price levels, suggesting limited market participation and lower liquidity. This relationship highlights the importance of trading volume as a key driver of price discovery and market stability in the cryptocurrency ecosystem.

6.4 Investment Recommendation

Based on the combined analysis of price trends, volatility, trading volume, and market sentiment, Bitcoin and Ethereum emerge as relatively stable and dominant assets suitable for long-term investment strategies. Their high liquidity and strong market presence reduce execution risk and enhance price reliability.

For investors with higher risk tolerance, selected alternative cryptocurrencies may provide opportunities for short-term gains due to higher volatility and episodic price surges. However, such strategies should be accompanied by careful risk management and continuous market monitoring. Additionally, integrating sentiment indicators such as the Crypto Fear & Greed Index can support timing decisions and improve overall investment outcomes.

7 Conclusion

This project presented a comprehensive descriptive analysis of the cryptocurrency market using Microsoft Power BI. Through a structured workflow involving data preparation, descriptive analysis, dashboard design, and advanced analytical calculations, meaningful insights were extracted from historical cryptocurrency data.

The dataset was carefully cleaned and prepared to ensure reliability and compatibility with analytical tools. Key market characteristics such as price trends, volatility, trading volume, market capitalization, and monthly returns were examined using interactive visualizations. The results highlight the dominance of Bitcoin and Ethereum in terms of price, liquidity, and market capitalization, while also revealing the higher volatility and risk associated with several alternative cryptocurrencies.

The multi-page dashboard design enabled intuitive exploration of market behavior from different perspectives, including temporal trends, comparative analysis, and advanced insights into volume-price relationships. The integration of DAX calculations and external sentiment data, such as the Crypto Fear & Greed Index, further enriched the analytical depth of the project and provided additional context for understanding market dynamics.

Overall, this project demonstrates the effectiveness of Power BI as a business intelligence tool for financial and cryptocurrency market analysis. The resulting dashboards support data-driven decision-making and can be extended in future work by incorporating real-time data, predictive models, or additional macroeconomic indicators. The methodology and insights presented in this study provide a solid foundation for further exploration of digital asset markets.