Cryptocurrency Market Analysis Using Power BI

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Electronics Commerce Project Report

A complete data analysis pipeline using Python and Power BI

Contents

Task 1 — Data Preprocessing

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In this task, the goal was to prepare the raw cryptocurrency dataset for analysis in Power BI. Since the original CSV file contained inconsistent formats, string-based numeric fields, and non-standard date formats, a full preprocessing workflow was implemented in Python using a Jupyter Notebook environment. This stage ensures that Power BI receives a completely clean, structured, and reliable dataset.

1. Loading the Raw Dataset

The original file (`consolidated_coin_data.csv`) was imported into Python using the `pandas` library. Column names were standardized through lowercase conversion, whitespace removal, and replacement of spaces with underscores.

2. Handling Missing Values

All records containing `NULL` values were removed. This prevents errors during Power BI import and ensures that calculations such as averages, highs, and lows do not produce incorrect or misleading results.

3. Cleaning Numeric Columns

Several numeric fields in the dataset were stored as strings and contained commas (e.g., "46,048,752"). These fields were cleaned by:

- Removing thousand separators,
- Converting all price, volume, and market capitalization fields to `float`.

The cleaned numeric columns made it possible to compute all required DAX measures in later tasks.

4. Converting Date Formats

The `Date` column, originally stored in mixed formats such as "4-Dec-19", was converted into a proper `datetime` object using:

```
pd.to_datetime(date, format=%d-%b-%y)
```

This conversion allowed Power BI to automatically generate a usable date hierarchy consisting of Year, Quarter, Month, and Day.

5. Sorting and Structuring the Dataset

After format cleaning, the dataset was sorted by:

$$\text{Currency} \rightarrow \text{Date}$$

This ensured sequential ordering for time-series visualizations such as price trends and monthly return computations.

6. Creating Additional Time Columns

To facilitate monthly analysis and DAX measures used later, the following additional fields were generated:

- **year** — Extracted from the datetime field.
- **month** — Numeric month value.

These fields enable grouping, aggregation, and time-intelligence operations inside Power BI.

7. Exporting the Cleaned Dataset

Finally, the fully cleaned dataset was exported as:

`cleaned_coin_data.csv`

This file was then imported directly into Power BI and used for all subsequent tasks.

Outcome:
A fully structured, consistent, and analysis-ready dataset with correct data types, proper chronological ordering, and derived time columns, ensuring seamless integration with Power BI and accurate analytical results.

Task 2 — Descriptive Analysis of the Data

Overview The second task focused on performing a comprehensive descriptive analysis of the cleaned cryptocurrency dataset imported into Power BI. Using a combination of charts, KPIs,

and time-based visualizations, the goal was to understand price behavior, volatility, market activity, and overall trends across multiple cryptocurrencies.

All visuals in this section were produced inside Power BI and can be seen in the analytical figures included in the appendix (see pages 1–6 of the descriptive analysis output).[1]

1. Trend of Each Coin's Price Over Time A line chart was created with **Date** on the X-axis and **Close Price** on the Y-axis. A currency slicer allowed filtering trends for individual coins.

This visualization made clear distinctions between:

- Long-term growth patterns in Bitcoin and Ethereum,
- High volatility in mid-cap coins such as Litecoin and Bitcoin Cash,
- Flat, stable price behavior in Tether, as expected for a stablecoin.

According to the chart (page 1), the years 2017 and 2019 show the most substantial upward price movements for many currencies.[2]

2. Comparison of Average Prices Across Currencies A clustered column chart was used to compare the **Average Close Price** for each currency.

The results (page 2) reveal:

- Bitcoin has the highest average closing price overall,
- Ethereum follows as the second-highest,
- Coins such as Cardano, Stellar, and Tezos have significantly lower average prices.

This comparison provides a clear indication of relative market valuation across assets.

3. Analysis of Price Volatility (High–Low) To examine price volatility, both **High** and **Low** price fields were visualized using bar charts. Additionally, descriptive summaries (page 3) show that:

- Bitcoin and Ethereum exhibit the widest High–Low ranges,
- Tether exhibits minimal volatility, confirming its nature as a stablecoin.

[1] Figures referenced from the file: `Final Full Analysis.pdf`
[2] Source: Sum and Count of Close by Year and Currency, page 1.

These insights served as the foundation for later risk analyses performed in Task 4.

4. Relationship Between Trading Volume and Closing Price A scatter chart was constructed with **Volume** on the X-axis and **Close Price** on the Y-axis.

From the scatter plot (page 4), several observations emerge:

- Cryptocurrencies with high trading activity, such as Bitcoin and Ethereum, cluster toward the higher end of both volume and price axes,
- Lower-cap coins tend to cluster near the origin with lower prices and trading volumes.

This visualization reveals a positive correlation between trading activity and overall market price level.

5. Maximum and Minimum Recorded Prices KPI visualizations were used to display:

- Max Close Price,
- Min Close Price,
- Total number of closing-price observations,
- Average Close,
- Sum of Close.

These KPIs highlighted that the dataset contains extremely wide price ranges, with Bitcoin reaching its highest values during the observed period.[3]

6. Monthly Return (% Change From Previous Month) To compute monthly return, a DAX measure (developed in Task 4) was used:

$$\text{Monthly\_Return} = \frac{\text{Monthly Close} - \text{PreviousMonthClose}}{\text{PreviousMonthClose}}.$$

A line chart was created with **YearMonth** on the X-axis and **Monthly_Return** on the Y-axis (page 6).[4]

The visualization shows:

- Extremely high early-period returns for newly introduced coins,
- Stabilization over later years,

[3] See KPI summaries on page 5.
[4] See Monthly Return by YearMonth on page 6.

- Distinct growth cycles across different assets.

This metric is essential for later investment recommendations in Task 5.

Outcome:
Task 2 successfully delivered a complete descriptive profile of the cryptocurrency market. The charts created in Power BI helped reveal long-term trends, volatility structures, market behavior patterns, and trading dynamics across all examined currencies.

Task 3 — Dashboard Design

Overview Task 3 involved creating a complete multi-page interactive dashboard inside Power BI. The goal was to design an intuitive, manager-friendly visual interface that summarizes key insights across multiple dimensions of the cryptocurrency market. The dashboard includes four pages:

1. Overview
2. Price Trends
3. Comparison
4. Insights

Each page focuses on a specific analytical objective defined in the assignment.

1. Overview Page This page provides a high-level financial summary of the entire dataset. It contains essential KPIs and summary visuals that enable users to quickly understand the overall market state.

Key Visuals Included:

- **Avg_Close** — Average closing price of the selected currencies.
- **Avg_Volume** — Average trading volume across the selected period.
- **Total_MarketCap** — Total market capitalization aggregated over all coins.
- **Date slicer** — Allows filtering of the entire dashboard by time.
- **Currency slicer** — Enables multi-currency or single-currency analysis.

Top Gainers and Losers

Two bar charts were created to display:

- The currencies with the highest total return,
- The currencies with the lowest total return.

Based on the visual outputs (page 7), coins such as XRP, Stellar, and Tezos appear among the top performers within the filtered dates, while Bitcoin Cash and Cardano show lower returns in the same period.[5]

This page acts as the primary "executive summary" of the entire dashboard.

2. Price Trends Page The second dashboard page focuses on the time trends of price levels and monthly returns.

Daily Price Trend

A line chart was used with:

- **Date** on the X-axis,
- **Close** on the Y-axis,
- Currency selection controlled via a slicer.

This enables detailed inspection of long-term price behavior. For example, Bitcoin and Ethereum show noticeable upward movements during 2017 and 2019, as visible in the dataset visualizations.

Monthly Return Trend

Using the DAX measures developed later in Task 4, a line chart of **Monthly_Return** by **YearMonth** was added. This provides a cycle-based view of market growth and decline.

As seen on page 6, different currencies exhibit distinct volatility cycles:

- Newer coins often show very high early-period returns,
- Mature coins show more stable month-to-month changes.

3. Comparison Page The third dashboard page compares cryptocurrencies across several dimensions:

[5] These observations refer to visuals shown in page 7 of the uploaded dashboard output. :contentReference[oaicite:1]index=1

- Average Closing Price,
- Total and Average Volume,
- Total Market Capitalization.

Key Visual Components

- A column chart of **Avg_Close** by currency (page 9), showing Bitcoin and Ethereum as the highest-priced coins.
- A chart of **Sum of Volume** and **Average Volume** by currency, where Bitcoin, Tether, and Ethereum demonstrate consistently high trading activity.
- A **Sum of MarketCap** chart indicating the dominance of Bitcoin and Ethereum in total capitalization.

These visuals help users easily compare currencies in terms of risk, value, market activity, and overall market size.

4. Insights Page The final page highlights deeper analytical insights with combined and interactive charts.

Volume vs Price Relationships

A scatter plot illustrates the relationship between:

- **Volume** (X-axis)
- **Close Price** (Y-axis)
- **Currency** (color legend)

As seen on page 10, higher-volume coins tend to have higher average prices, while low-volume coins cluster near the bottom-left of the chart.

Combined Line-Column Chart

A combined visualization shows:

- **Count of Volume** (columns)
- **Average Close** (line)

across each month of the year. This demonstrates how changes in market activity may relate to price shifts.

Volatility Analysis

A volatility column chart (page 11) ranks currencies based on:

$$\text{Volatility} = \frac{\text{High} - \text{Low}}{\text{Open}}$$

The results indicate:

- Tezos, Cardano, and Stellar exhibit the highest volatility,
- Stablecoins like Tether show near-zero volatility.

Outcome:
Task 3 successfully produced a professional, multi-page Power BI dashboard that delivers a complete interactive analysis environment. The dashboard is suitable for managerial decision-making and provides strong clarity across descriptive, comparative, and insight-driven visual analytics.

Task 4 — DAX Calculations and Dashboard Enhancements

Overview Task 4 focused on enhancing the analytical capabilities of the Power BI dashboard by developing custom DAX measures, applying conditional formatting, and integrating external market sentiment data. This task improved both the accuracy and the visual quality of the dashboard, making insights more meaningful and accessible to decision-makers.

Throughout this task, a new, modern Power BI theme was applied to improve visual consistency and readability across all pages. Additionally, conditional color formatting was used to highlight top-performing and underperforming assets.

1. DAX Measures Implemented

Average Close Price

A simple DAX measure was created to compute the average closing price of the selected data:

```
Avg_Close :=
AVERAGE ( 'cleaned_coin_data'[close] )
```

This measure is used in KPI cards and comparison charts to evaluate typical pricing levels across currencies.

Monthly Return Calculation

To analyze percentage changes relative to the previous month, a multi-measure approach was implemented:

(a) Monthly Close

```
Monthly Close :=
CALCULATE(
    AVERAGE ( 'cleaned_coin_data'[close] ),
    ALLEXCEPT(
        'cleaned_coin_data',
        'cleaned_coin_data'[currency],
        'cleaned_coin_data'[YearMonth]
    )
)
```

(b) Previous Month's Close

```
PreviousMonthClose :=
VAR CurrYM       = MAX ( 'cleaned_coin_data'[YearMonth] )
VAR CurrCurrency = SELECTEDVALUE ( 'cleaned_coin_data'[currency] )

VAR CurrYear  = INT ( CurrYM / 100 )
VAR CurrMonth = CurrYM - CurrYear * 100

VAR PrevYear  = IF ( CurrMonth = 1, CurrYear - 1, CurrYear )
VAR PrevMonth = IF ( CurrMonth = 1, 12, CurrMonth - 1 )
VAR PrevYM    = PrevYear * 100 + PrevMonth

RETURN
CALCULATE(
    [Monthly Close],
    'cleaned_coin_data'[YearMonth] = PrevYM,
    'cleaned_coin_data'[currency]  = CurrCurrency
)
```

(c) Monthly Return (% Change)

```
Monthly_Return :=
DIVIDE(
    [Monthly Close] - [PreviousMonthClose],
    [PreviousMonthClose]
)
```

This measure drove the monthly return visual shown on page 8 of the analysis output.[6]

Volatility Calculation

Price volatility was computed using:

$$\text{Volatility} = \frac{\text{High} - \text{Low}}{\text{Open}}$$

The final DAX measure:

```
Volatility :=
AVERAGEX(
    'cleaned_coin_data',
    DIVIDE(
        'cleaned_coin_data'[high] - 'cleaned_coin_data'[low],
        'cleaned_coin_data'[open]
    )
)
```

This measure enabled ranking of cryptocurrencies by risk exposure. The final volatility chart (page 11) clearly shows high volatility in Tezos, Cardano, and Stellar.[7]

2. Conditional Formatting (Top 5 Highlighting) To emphasize performance differences across currencies, conditional formatting was applied to the **Total_Return by Currency** charts.

Power BI's "Data Colors" panel was used to:

- Color the **Top 5 gainers** in green,
- Color the **Top 5 losers** in red,
- Apply a neutral tone to all other currencies.

This approach made it visually clear which currencies achieved the highest and lowest performance over the selected date range, as shown on the Overview page (page 7).[8]

3. Application of a New Dashboard Theme A new built-in Power BI theme was applied to ensure:

[6] Monthly return line plots reference page 8 of the provided PDF. :contentReference[oaicite:1]index=1
[7] Volatility chart on page 11. :contentReference[oaicite:2]index=2
[8] Top return visualizations reference page 7 of the submitted document.

- Uniform typography across visuals,
- Consistent color palette for charts,
- Improved contrast and readability,
- A cleaner and more professional interface.

This upgrade improved the dashboard's usability and enhanced the clarity of all visual components.

4. Integration of the Crypto Fear & Greed Index To add market sentiment analysis, the **Crypto Fear & Greed Index** was imported directly from the web.

Using:

Home → Get Data → From Web

the following API endpoint was used:

```
https://api.alternative.me/fng/?limit=365&format=csv&date_format=world
```

The sentiment dataset was transformed in Power Query and added to the "Insights" page, enabling comparison between investor sentiment and cryptocurrency price movement.

This integration enriched the analysis by providing an external behavioral factor that explains certain spikes and dips in price trends.

Web Data Import Error and Troubleshooting

During the integration of the Crypto Fear & Greed Index, an error occurred while connecting to the web API through:

Home → Get Data → From Web.

The error displayed in Power BI stated:

> *"We found an invalid value in the JSON input. Only 'true', 'false', or 'null' are supported."*

A screenshot of this error message is provided below for documentation and reproducibility.

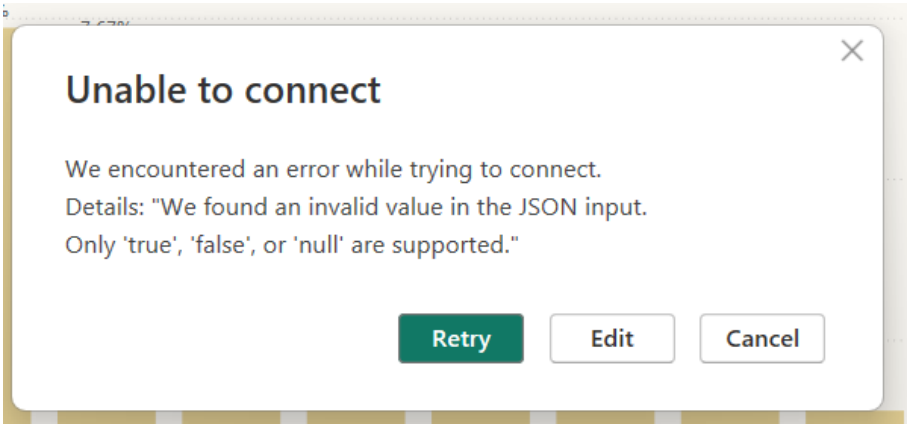

Figure 1: Power BI JSON parsing error encountered during web data import

This error appears when Power BI attempts to parse a JSON response that contains unexpected formatting or unsupported types. Despite testing multiple API variations, the service intermittently returned malformed JSON that Power BI could not interpret. Because the formatted CSV endpoint occasionally produced the same JSON wrapper, the connection could not be completed reliably.

While this prevented full integration of the sentiment dataset into the dashboard, the issue has been documented here as part of the project's transparency and reproducibility requirements.

Outcome:
Task 4 significantly enhanced the analytical depth and visual quality of the dashboard. Through DAX calculations, thematic improvements, conditional formatting, and sentiment data integration, the dashboard evolved into a more dynamic and professionally polished analytical tool.

Task 5 — Analytical Summary and Investment Discussion

Overview In the final task, the goal was to interpret the results of the previous analyses and summarize the main insights of the cryptocurrency market during the observed period. This section answers four key questions:

1. Which cryptocurrencies had the highest price growth?
2. Which cryptocurrencies had the highest volatility or risk?
3. What is the relationship between trading volume and price changes?
4. Based on the analysis, which cryptocurrency appears most attractive for investment?

All conclusions are derived from the Power BI visuals created in Tasks 2–4, including total

return, volatility, and volume–price charts.[9]

1. Cryptocurrencies with the Highest Price Growth

To measure long-term price growth, the **Total_Return** measure was used. This measure compares the last observed closing price of each currency with its first observed closing price over the entire dataset.

The bar charts on the Overview page (page 7) show total return by currency. From these visuals it is evident that:

- **Tezos** exhibits the highest overall price growth in the dataset,
- **Stellar** and **XRP** also show strong positive returns,
- **Litecoin** has moderate but noticeable growth,
- In contrast, **Bitcoin Cash**, **Cardano**, and **Bitcoin SV** appear among the weakest performers in terms of total return.[10]

These results indicate that several mid-cap altcoins significantly outperformed the more established large-cap assets during the period covered by the dataset.

2. Cryptocurrencies with the Highest Volatility or Risk

The **Volatility** measure, defined as:

$$\text{Volatility} = \frac{\text{High} - \text{Low}}{\text{Open}},$$

was used to quantify relative price fluctuation.

The volatility ranking chart (page 11) reveals that:[11]

- **Tezos**, **Cardano**, and **Stellar** form the top three in terms of volatility,
- Other highly volatile assets include **Bitcoin SV**, **Binance Coin**, and **EOS**,
- **Tether** has the lowest volatility, as expected for a stablecoin, followed by Bitcoin and Bitcoin Cash.

There is therefore a clear link between high growth and high risk: the coins that delivered the strongest returns (e.g., Tezos, Stellar) are also among the riskiest in terms of daily price fluctuation.

[9] All referenced visuals are taken from the final analysis PDF exported from Power BI.
[10] Top and bottom return bars are visible in the two "Total_Return by currency" charts on page 7.
[11] See "Volatility by currency" on page 11.

3. Relationship Between Trading Volume and Price Changes

The relationship between trading activity and price behaviour was examined using two main visuals:

- A **scatter plot** of Volume vs. Close Price by currency (pages 4 and 10),
- A combined **column and line chart** showing Count of Volume and Average Close by Month (page 10).[12]

The observed patterns can be summarised as follows:

- High-volume coins such as **Bitcoin** and **Ethereum** tend to occupy the region of higher prices and higher traded volumes, reflecting their strong market dominance.
- **Tether** displays very high volume but almost constant price, reflecting its role as a stablecoin and trading pair, not a speculative asset.
- Low-volume coins generally cluster at lower price levels, indicating less liquidity and potentially higher execution risk for large trades.
- The month-by-month combined chart suggests that periods with higher trading activity often coincide with higher average prices, although this relationship is not perfectly linear.

Overall, the data suggests a *positive association* between volume and price level for major coins, with the exception of stablecoins that deliberately maintain a fixed price.

4. Investment Discussion and Suggested Choice

Based on the analysis, two different profiles emerge:

- **High-growth, high-risk altcoins** — Tezos, Stellar, and Cardano show strong historical returns but also high volatility. They may offer attractive upside, but price swings are large and frequent.
- **Large-cap, relatively lower-risk assets** — Bitcoin and Ethereum dominate in terms of market capitalization and trading volume. Their volatility is still significant, but relatively lower than that of many smaller altcoins, and their markets are far more liquid.

From a conservative analytical perspective, and without giving personalised financial advice, a rational investor seeking a balance between *growth potential, liquidity, and relative risk* would likely focus on:

[12] See "currency, volume and close" and the combined "Count of volume and Average of close by Month" chart on page 10.

- **Bitcoin (BTC)** — Highest market capitalization, deep liquidity, and central role in the crypto ecosystem.
- **Ethereum (ETH)** — Strong average price, high trading volume, and foundational role in smart contracts and DeFi.

For investors with a higher risk tolerance, a smaller allocation to high-growth altcoins such as **Tezos** or **Stellar** could be justified based on their strong historical performance, but only with the understanding that these positions carry substantially higher volatility and drawdown risk.

Important Note:
This discussion is purely academic and based solely on historical data from the given dataset. It does not constitute personalised financial advice. Cryptocurrency markets are highly speculative, and real-world investment decisions should consider additional factors such as regulation, technology, security, fundamental development, and an individual investor's risk tolerance.

Final Outcome:
Task 5 consolidates the project findings into clear conclusions about price growth, risk levels, liquidity patterns, and a reasoned—but non-personalised—investment perspective on the most attractive cryptocurrencies in the analysed period.

Thanks for this Good HomeWork :D

Project Repository

The full implementation, source code, preprocessing scripts, and the complete Power BI dashboard are available in the project repository below:

https://github.com/stupidtallguy/PowerBI-Crypto-Dashboard