Capstone Project Report

Title: Analyzing Bitcoin vs. Traditional Financial Assets and a look into Financial Astrology (2017-2025)

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1. Project Overview and Problem Statement

1.1. Background:

Cryptocurrencies and digital assets have grown in popularity as alternative investments, often outperforming traditional assets. Bitcoin, as the first cryptocurrency, has gained massive popularity in its short 16 year history since its launch in 2009. It has gone through cycles of massive gains as well as cycles of massive drawdowns, however, its users continue to push forward its use as an alternative asset capable of competing with traditional assets in the open market. Today, it ranks 7th. largest asset in the world with a total market cap of $2 Trillion.

Meanwhile, astrology has gained popularity as an unconventional trading strategy and a way to analyze market behavior and price movements. In particular, I'll be taking a look at a popular trading strategy which tracks the moon phases to make trading decisions, as well as the effects on price when the planet Mercury is in Retrograde.

This project aims to analyze Bitcoins performance vs. traditional assets and effectiveness of astrology based strategies alongside traditional performance metrics.

1.2 Problem Statement:

How has Bitcoin performed against traditional assets such as the S&P 500, NASDAQ-100 and Gold and is there any correlation between them? Is there a connection between the moon phases, planet Mercury in Retrograde and price movements? Does the moon phase trading strategy perform better than the buy and hold strategy?

1.3 Objectives

- Compare the historical performance of Bitcoin vs. traditional assets from 2017 to 2025 using traditional financial metrics.
- Quantify the impact of astrological events (Moon Phases, Mercury Retrogrades, Eclipses) on Bitcoin's returns.

2. Data Description

2.1 Data Sources

This project used data from three primary sources from the period **January 1, 2017 to May 31, 2025**:

- **Bitcoin & Traditional Asset Price Data**

Daily historical price data for Bitcoin, SPY (S&P 500), QQQ (NASDAQ-100), and GLD (Gold) was extracted using the TIINGO API. This included open, high, low, close, and volume data from January 1, 2017 to May 31, 2025.

- **Astrology Data**

  Planetary position data was obtained using the Skyfield API, a Python astronomy library. It was used to calculate the longitudinal motion of Mercury to determine when the planet was in retrograde from Earth's perspective.

- **Moon Phase Data**

  A clean, pre-processed dataset was sourced from a public GitHub repository by Isaac Bernat. It included daily moon phase classifications, which were later categorized into named phases (e.g., new moon, full moon) for strategy modeling.

2.2 Data Cleaning and Preprocessing

Extracted the traditional assets price data via the TIINGO API in a single pandas dataframe. The dataset contains 6,342 rows and 15 columns. The Bitcoin price data was also extracted from the TIINGO API and contained

For this analysis I combined 4 data sets starting with the moon phases from Isaac Bernat's github. The data set was already clean, with 3,073 rows and 5 columns. I only added an additional column to categorize the moon phases by its name, as the data set categorized them by integers (1-8). The second data set containing the position of the planet Mercury was pulled from the Skyfield API, which is a python astronomy library developed by Brandon Rhodes. I pulled the date and planet longitude position of Mercury relative to Earth. After pulling the data I was left with a data frame that contained 3,073 rows and 2 columns. I added a new column to calculate the difference in longitude from one day to the next. This gave either positive or negative integers. A planet is in retrograde when it appears to move backwards in the sky from our perspective on earth. Based on the previous calculation if the result is a positive integer it means that the planet is not in retrograde. Conversely, if the result is a negative integer it means that the planet is in retrograde. Based on that result, I added a third column to categorize if the planet was in retrograde or not.

The third data set containing the price data for traditional assets was pulled from TIINGO API containing the daily price movements of the three assets. For each asset data frame I added a new column with the name of each asset. Finally, I combined all three data frames into a single one, which contains 10,915 rows and 9 columns. The fourth data set containing the daily price data of Bitcoin was also pulled from the TIINGO API. The bitcoin data frame has a total of 3,074 rows and 8 columns.

In the next step I prepared the traditional assets and bitcoin data frames to combine them into a single data frame. I renamed some columns so that they matched and selected the necessary

columns in both data frames. Once combined into a single data frame, I performed all the necessary calculations (daily returns, cumulative returns, sharpe ratio, correlation, price drawdown, volatility, yearly returns).

In the last step, I merged the assets data frame with the moon phases and mercury in retrograde data frames into a single data frame. The final data frame contains 9,416 rows and 22 columns.

3. Analysis

To perform this analysis I used a series of financial metrics to compare the performance of each asset over time. The metrics used were the following:

3.1 Financial Metrics:

- *Daily Returns:* The percentage change in price from one day to the next.
- *Monthly Returns:* The percentage change in price over a calendar month.
- *Cumulative Returns:* the aggregate amount that an investment has gained or lost over time expressed as a percentage. This shows the long performance and growth of the asset. I calculated this metric by multiplying each day's return (1 + daily return) in sequence.
- *Volatility*: It measures how much an asset's returns vary over time. Higher volatility means higher risk. I calculated this metric by taking the standard deviation of daily returns.
- *Sharpe Ratio:* A measure of an asset's returns relative to risk. Tells you how much reward you're getting for each unit of risk taken. I calculated this by taking the average daily returns divided by the daily volatility/standard deviation.
- *Drawdown:* Measures how much an asset dropped from the highest point of cumulative returns. It shows how much the asset has lost during a decline. This is calculated by getting the highest cumulative return so far and subtracting the current cumulative return from that peak, and dividing by the peak.
- *Correlation:* Measures how two assets move in relation to each other. It ranges from -1(opposite) to 1(move together). It was calculated using the correlation function in pandas with the daily returns of two assets.

3.2 Astrology Metrics:

To explore the relationship between astrological events and Bitcoin price behavior I created date based indicators for three key astrological events: Mercury retrograde periods, solar and lunar eclipses, and lunar phases.

- **Mercury Retrograde:** Compared the average daily returns and 30-day rolling volatility for each group.
- **Eclipses:** I analyzed the 3-day rolling volatility and average daily returns around the eclipse window to evaluate short-term market behavior.

- **Lunar Cycles:** I defined two trading strategies and compared the compounded yearly returns to a Buy & Hold strategy:
    a. Full Moon Strategy: Buy on the new moon, sell on the full moon.
    b. New Moon Strategy: Buy on the full moon, sell on the new moon.

4. Key Findings

4.1 Bitcoin vs. TradFi

The price of bitcoin has gone from $1,000 dollars per coin in 2017 all the way up to $111,000 in 2025. The cumulative returns of Bitcoin from 2017 to 2025 amount to a staggering 10,500%. When compared to GLD (275%), QQQ (460%), SPY (300%), it clearly shows the appeal and explosive nature of the asset in terms of potential returns. However, the volatile nature of the asset makes it an extremely risky investment. When looking at the rolling 30 day volatility of Bitcoin compared to traditional assets, you can clearly see the risk involved when investing in the asset. From 2017 to 2021 you can see that the rolling volatility moved sharply from 1.7% to 7.2% across the years. When looking at the rolling volatility from 2022 to 2025 you can see that it decreased significantly moving from a maximum of 4.4% in 2022 and 1.4% in 2023. The movements in volatility stayed a lot closer after 2022, moving 1.5% on average across the years, which suggests that the asset is maturing.

This makes sense because after 2017 Bitcoin gained massive popularity attracting much more investors including traditional investors which normally stayed away from these types of assets due its volatile and unpredictable nature. This has led to significant increases in price. This is not to say that Bitcoin has not gone through extreme downturns in this period. Historically, Bitcoin has moved in 4 year cycles. These cycles begin after the supply of new coins coming into the markets is cut in half and it's commonly known as “The Halving”. This is a programmed feature of the asset which cuts the reward for miners that verify transaction blocks, which consequently creates a supply shock. Bitcoin has gone through 4 cycles since its start, and they have been followed by an explosion in price lasting about 12 to 18 months after the supply coming to market is cut in half. This event is the start of the so-called Bull Market and investors begin accumulating the asset. At some point during those 12 to 18 months the price reaches a peak and investors start taking profits, causing a steady decline in price and marks the beginning of a bear market. During the 2017 to 2020 cycle Bitcoin saw a maximum drawdown of 84% from its peak price of $20,000 falling to $3,000. The same trend can be seen in the 2020 to 2024 cycle when it reached a maximum price of $67,000 followed by a 76% drawdown dropping the price back down to $15,000. We are still going through the 2024 to 2028 cycle and we’ve already seen the price reach a new high of $111,000 as mentioned previously, but we are not yet able to see what will happen or if the trend will remain the same as previous cycles. What is clear, is that with each cycle we’re seeing higher highs and higher lows.

In 2024, the Bitcoin ETF’s were approved, which now gave institutional investors the ability to invest in the asset by way of a proxy. This has been one of the main drivers for the price increase to new highs crossing the $100,000 mark. This has set a new era for the asset and it is

expected to continue driving the asset's price as more investors and bigger money have access to the asset.

In terms of the correlation of Bitcoin with traditional assets, I was able to observe that in the 2017 to 2019 period the correlation with the QQQ and SPY assets was very low between 0.0038 and 0.043 and even showed a negative correlation in some years. It's not until 2020 that we see a massive spike in its correlation with both assets staying above 0.20 and reaching a maximum correlation of 0.55 with the SPY ETF and 0.57 with the QQQ ETF in 2020. This suggests that Bitcoin is maturing and starting to behave more like a stock in terms of price movements.

Bitcoin has long been compared to gold, some calling it "Digital Gold", and like gold it is considered a commodity. There is no one central issuer or company controlling its issuance. Gold has long been considered a "Safe Haven" asset as it has historically shown its ability to maintain or increase its value in times of political and economic uncertainty. Investors usually flock to gold during these times. When analyzing its correlation to Bitcoin in the period of 2017 to 2019 it showed little correlation between 0.01 and 0.02 in 2017 and 2018, with a small increase to 0.15 in 2019 and reaching a peak correlation of 0.34 in 2020. It was followed by a negative correlation of -0.0208 in 2021 and jumping back up to 0.16 in 2022, but stayed between 0.10 and 0.12 in 2023 and 2024. In 2025 so far we're seeing a decrease all the way down to 0.0132. These results suggest that Bitcoin is not yet being treated as a safe haven asset like gold and is still being used more like a speculative asset and at times more like a stock.

4.2 Astrology Insights

Astrology has long been used in human decision-making for centuries, guiding everything from personal relationships to career choices. But in recent years, there has been an increased interest in exploring astrology's role in financial markets and economic trends. It is believed that the famous financier J.P Morgan used astrology to aid his financial decisions, and reportedly said, "Millionaires don't use astrology, billionaires do". This is all anecdotal and there is no hard evidence he ever said this.

For this analysis, I chose to look at the following astrological events: Mercury in Retrograde, Lunar Cycles, Solar and Lunar Eclipses. In scientific terms, Mercury in Retrograde means a period of time when the movement of the planet around the sun appears to be reversed, with the planet moving from east to west instead of its usual west to east movement. This phenomenon happens 3-4 times a year and usually only lasts a few weeks at a time before the planet corrects its movement. This period is believed to bring about disruptions in communication, technology, and confusion.

4.3 Volatility and Return Analysis: Mercury Retrograde vs Normal Periods

To explore the impact of astrological events on Bitcoin's behavior, I compared both 30-day rolling volatility and average daily returns during periods when Mercury was in retrograde versus normal periods.

30-Day Rolling Volatility Comparison

Metric	Normal Days	Mercury Retrograde
Upper Whisker	6.47%	7.08%
Upper Hinge (Q3)	4.10%	4.29%
Median	3.09%	3.50%
Lower Hinge (Q1)	2.49%	2.39%
Lower Whisker	0.89%	1.21%

- Bitcoin exhibited slightly higher volatility during Mercury retrograde, with a higher median (3.50% vs 3.09%) and a wider interquartile range.

- The range of typical volatility values was also higher, suggesting more frequent episodes of large price swings during retrograde periods.

Average Daily Returns Comparison

Period	Normal Days	Retrograde
2017	0.32%	0.35%
2018	0.0%	-0.40%
2019	0.20%	-0.07%
2020	0.30%	-0.04%
2021	0.01%	0.54%
2022	-0.09%	-0.23%
2023	0.16%	0.20%
2024	0.12%	0.26%
2025	0.19%	-0.34%

- In some years, such as 2018, 2019, 2020, 2022, and 2025, Mercury Retrograde periods were associated with lower or more negative average daily returns compared to normal

days. Notably, 2018 saw normal days at 0.0% but retrograde at -0.40%, and in 2025, normal days were positive at 0.19% while retrograde turned negative at -0.34%.

- Conversely, in 2017, 2021, 2023, and 2024, retrograde periods demonstrated higher or more positive average daily returns. For instance, in 2021, retrograde returns were significantly higher at 0.54% compared to 0.01% on normal days, and in 2024, retrograde returns were 0.26% versus 0.12% for normal days.

Given these fluctuating year-to-year results, where retrograde periods sometimes outperformed and at other times underperformed, no consistent pattern can be established for Bitcoin's average daily returns during Mercury Retrograde.

4.4 Moon Phase Strategy Performance

For the moon phase trading strategies I did a comparison of the following strategies:

- Full Moon Strategy:

Volatility and Return Analysis: Solar vs Lunar Eclipses

Metric	Lunar Eclipse	Solar Eclipse
Upper Whisker	4.65%	4.20%
Upper Hinge (Q3)	2.48%	2.57%
Median	1.00%	0.97%
Lower Hinge (Q1)	0.69%	0.71%
Lower Whisker	0.17%	0.23%

Lunar Eclipse Volatility:

- The median volatility during lunar eclipses is 1.00%. This indicates a relatively low typical volatility.
- The Interquartile Range (IQR) from 0.69% to 2.48% shows that the middle 50% of volatility values are quite spread out.
- The whiskers extend from 0.17% to 4.65%, suggesting a wide range of observed volatility, with some significant higher-end movements possible.

Solar Eclipse Volatility:

- Solar eclipses show a very similar median volatility of 0.97%, almost identical to lunar eclipses.
- The IQR, ranging from 0.71% to 2.57%, also reflects a similar spread in the central 50% of data.

- The whiskers span from 0.23% to 4.20%, again indicating a broad range of volatility outcomes, comparable to lunar eclipses.

Key Takeaways:

Our updated analysis reveals that Bitcoin volatility during both lunar and solar eclipses is remarkably similar. Both periods exhibit a **low median volatility (around 1%)** but demonstrate a **considerable range in overall volatility**, with potential for higher spikes. There are no significant differences in the distribution of Bitcoin volatility between lunar and solar eclipses based on these updated results."

Average Daily Returns Comparison

Period	Normal Days	Lunar Eclipse	Solar Eclipse
2017	0.33%	0.09%	-0.61%
2018	-0.07%	-1.82%	0.67%
2019	0.16%	-2.96%	0.72%
2020	0.23%	0.95%	-0.09%
2021	0.12%	0.55%	-1.64%
2022	-0.11%	-1.42%	1.07%
2023	0.17%	1.06%	-0.59%
2024	0.14%	0.57%	0.49%
2025	0.09%	2.03%	-2.08%

An analysis of average daily returns reveals varied performance across normal days, lunar eclipse periods, and solar eclipse periods from 2017 to 2025.

- Normal Days generally exhibited consistent positive average daily returns, with expected negative periods aligning with broader market downturns (e.g., 2018, 2022).
- For Lunar Eclipse periods, the impact on average daily returns was highly inconsistent year-to-year. While some years saw positive returns (e.g., 0.95% in 2020, 2.03% in 2025), others experienced significant negative returns (e.g., -1.82% in 2018, -2.96% in 2019). This suggests that lunar eclipses do not consistently correlate with a specific directional bias in Bitcoin's daily price movements.
- Similarly, Solar Eclipse periods also showed considerable variability. Positive average daily returns were observed in several years (e.g., 0.67% in 2018, 1.07% in 2022), but negative returns were also prominent in others (e.g., -0.61% in 2017, -2.08% in 2025).

A key observation here is the consistent opposing trend between lunar and solar eclipse returns. For most years, when lunar eclipse periods saw positive average daily returns, solar eclipse periods tended to be negative, and vice-versa. While they often moved in opposite directions, this pattern doesn't point to a reliable trading signal.

4.5 Moon Phase Strategy Performance

- 2017: All strategies performed strongly during Bitcoin's parabolic bull run, but buy-and-hold significantly outperformed, returning over 1200%. Lunar strategies captured some of the upside, returning +406% (full moon) and +387% (new moon).

- 2018 (Bear Market): All strategies posted negative returns. However, lunar-based strategies reduced the losses, with the new moon strategy showing losses of −47%, compared to −70% for buy-and-hold.

- 2019–2020: Buy-and-hold again led, but the full moon strategy captured substantial gains, especially in 2020 (+274% vs buy-and-hold's +303%). The new moon strategy underperformed in these years, even turning slightly negative in 2020.

- 2021: A key exception. The new moon strategy returned +255%, far outperforming both buy-and-hold (+59%) and full moon (−51%).

- 2022 (Bear Market): Again, lunar strategies offered downside protection, especially the new moon strategy, which limited losses to −39% compared to −64% for buy-and-hold.

- 2023–2024: In more stable and bullish conditions, buy-and-hold regained leadership, delivering +156% in 2023 and +121% in 2024. Lunar strategies posted positive but lower returns, led by the full moon strategy (+62%) in 2024.

5. Conclusions

5.1 Summary of Insights

The analysis revealed that Bitcoin significantly outperformed traditional financial assets such as the S&P 500, NASDAQ-100, and Gold in terms of cumulative returns from 2017 to 2025. However, this outperformance came with considerably higher volatility and drawdowns, particularly during bear market cycles. Bitcoin's correlation with traditional assets increased after 2020, suggesting that it is maturing and beginning to behave more like a tech stock, although it remains fundamentally different in structure and utility.

From an astrological perspective, the analysis showed that Mercury retrograde periods were associated with slightly higher volatility and marginally weaker daily returns, although both retrograde and normal periods yielded positive performance. Lunar and solar eclipses showed

modest but noticeable effects: lunar eclipses coincided with elevated short-term volatility and slightly negative returns, while solar eclipses had lower volatility on average and slightly positive returns. These patterns may reflect shifts in sentiment or behavior during these timeframes, though no causal relationship can be confirmed.

The moon phase trading strategies (full moon and new moon) provided mixed results. While the buy-and-hold strategy generally delivered the strongest long-term returns, the lunar strategies demonstrated reduced downside in bear markets and strong outperformance in select years, notably 2021. This suggests they may offer tactical value in certain market conditions but are not consistently superior.

5.2 Recommendations

From a financial analysis standpoint, Bitcoin presents a compelling long-term investment opportunity but demands careful risk management due to its high volatility.

Regarding astrology-based strategies, while the findings are intriguing, they should be viewed as exploratory, not as primary decision-making tools. The patterns identified during Mercury retrogrades, eclipses, and moon phases may serve as timing overlays or behavioral markers for further analysis, but no trading decisions should be made solely on astrological events.

5.3 Limitations

The astrology-based analysis is correlational, not causal. Any observed relationships between planetary events and market behavior may be coincidental or influenced by external factors not accounted for in this study.

The lunar cycle strategies are based on a fixed timing model for traditional metrics and macroeconomic scenarios which could significantly impact real-world performance.

The eclipse data used focused on exact dates, without accounting for possible extended market influence before or after the event.

Results may be sample-specific, limited to the 2017–2025 timeframe, which includes both bull and bear markets but may not capture all possible macroeconomic scenarios.

Lastly, astrology remains a non-scientific framework. While this project treats it analytically, it is not grounded in financial theory and should be interpreted with that context in mind.

6. Resources

6.1 Tools and Software

- **Python**: Used as the primary programming language for data extraction, cleaning, transformation, and analysis.

- **Pandas**: A Python library used for handling and manipulating dataframes, calculating financial metrics and merging datasets.

- **Skyfield API**: A Python astronomy library used to calculate planetary positions and determine Mercury retrograde periods based on its longitudinal motion.

- **TIINGO API**: Used to extract historical daily price data for Bitcoin and traditional financial assets (SPY, QQQ, GLD).

- **Tableau**: Used for creating interactive visualizations and dashboards to display cumulative returns, volatility, correlation, moon phase strategy performance, and astrological overlays.

6.2 References

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