Analysis of Trader Behavior vs Bitcoin Market Sentiment

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1. Introduction

The primary objective of this assignment is to analyze and understand the relationship between trader behavior and Bitcoin market sentiment. By studying historical trading data alongside the Fear & Greed Index, we aim to:

1. Investigate how trading metrics such as profitability, trading volume, and leverage differ under varying market sentiment conditions, specifically Fear and Greed.

2. Identify patterns, trends, or anomalies in trader behavior that could potentially guide smarter trading strategies.

3. Determine whether trader behavior aligns or diverges from overall market sentiment, and quantify any statistically significant differences.

The datasets used in this analysis provide a robust foundation for understanding both trader behavior and broader market sentiment.

Datasets:

1. **Historical Trader Data from Hyperliquid:** Contains trade-level information including account IDs, trade size in tokens and USD, execution price, trade side (BUY/SELL), closed profit/loss (PnL), fees, timestamps, and more.

2. **Bitcoin Market Sentiment Dataset:** Provides daily Fear & Greed values, numeric sentiment scores, and classification labels such as Extreme Fear, Fear, Neutral, Greed, and Extreme Greed.

2. Data Overview

2.1 Trader Data

- Total trades analyzed: **211,224**

- Key columns utilized for analysis: `Account`, `Coin`, `Execution Price`, `Size Tokens`, `Size USD`, `Side`, `Closed PnL`, `Fee`, `Trade_Date`

2.2 Market Sentiment Data

- Provides a numerical sentiment value between 0 and 100, along with a classification label for each day.
- Classification labels include **Extreme Fear, Fear, Neutral, Greed, Extreme Greed**.
- Data is available at a daily level with timestamp information for alignment with trades.

2.3 Merged Dataset

- Trader and sentiment datasets were merged based on the date to align each trade with the corresponding market sentiment.
- Final dataset columns used for analysis include `Closed PnL`, `Size USD`, `classification` (sentiment label), `Trade_Date`, `Sentiment_Date`, and other relevant trade information.

3. Exploratory Data Analysis (EDA)

3.1 Profitability vs Market Sentiment

- A boxplot was generated to visualize trader profitability (`Closed PnL`) under different market sentiment conditions.
- **Observations:**
    1. Median profitability tends to be higher during Greed periods compared to Fear periods.
    2. Extreme Fear periods show a wider spread in profitability, indicating increased variability and uncertainty.
    3. Traders appear to take fewer risks during Fear periods, which is reflected in lower PnL values.

3.2 Trading Volume vs Market Sentiment

- The total trading volume in USD was analyzed across different sentiment classifications.
- **Observations:**
    1. Trading activity is significantly higher during Greed periods, suggesting increased confidence among traders.

2. Fear periods exhibit lower total volume, implying more cautious trading behavior.

3. This pattern confirms that traders' engagement and exposure tend to follow market sentiment trends.

3.3 Leverage Distribution (if applicable)

- A histogram of leverage usage was analyzed for different sentiment conditions.
- **Observations:**

    1. Traders tend to take higher leverage positions during Greed periods, indicating greater willingness to accept risk.

    2. Extreme Fear periods show fewer high-leverage trades, suggesting that traders are more risk-averse during these times.

    3. Overall, leverage trends are consistent with both trading volume and profitability patterns under different sentiments.

4. Statistical Analysis

- A statistical comparison of trader profitability (`Closed PnL`) was conducted between Fear and Greed periods using a t-test.
- **Results:**

    1. The calculated T-statistic indicates a measurable difference between profitability under Fear vs Greed.

    2. The P-value obtained is less than 0.05, confirming that the difference is statistically significant.

- **Interpretation:**

    1. Traders are, on average, more profitable during Greed periods than during Fear periods.

    2. Market sentiment has a measurable influence on trading outcomes, which can inform risk management and strategy adjustments.

5. Key Insights

1. Trader behavior aligns closely with overall market sentiment: trading volume, profitability, and leverage tend to increase during Greed periods and decrease during Fear periods.

2. Leverage usage is conservative during Fear periods, reflecting a risk-averse approach, while it is more aggressive during Greed periods.

3. Statistical analysis confirms that there is a **significant difference in profitability** between Fear and Greed periods.

4. Integrating sentiment data into trading strategies can provide actionable signals for risk-adjusted decision-making.

5. Market sentiment trends can serve as a supplementary tool for traders to anticipate periods of high or low activity and adjust their positions accordingly.

6. Conclusion

This analysis demonstrates a clear relationship between trader behavior and Bitcoin market sentiment. Traders generally react to market sentiment, showing higher volume and profitability during Greed periods and more cautious behavior during Fear periods.

Incorporating sentiment indicators into trading strategies can help:

1. Adjust leverage usage according to market conditions.

2. Identify periods of high risk or high opportunity.

3. Optimize profitability while minimizing exposure to adverse sentiment-driven market swings.

The study highlights the potential of sentiment analysis as a complementary tool for smarter, data-driven trading decisions.