Analysis of Trader Behavior vs Market Sentiment on Bitcoin

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1. Introduction

The objective of this analysis is to explore the relationship between **trader behavior** and **market sentiment** in the Bitcoin market. Using historical trader data from Hyperliquid and the Fear & Greed Index, this study investigates how profitability, trading volume, and trading strategies are influenced by prevailing market sentiment (Fear or Greed).

The insights gained could help design smarter trading strategies and identify patterns in trader behavior under different market conditions.

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2. Datasets

2.1 Trader Data

- Source: Hyperliquid historical trader dataset
- Rows: 211,224
- Columns: 16 (Account, Coin, Execution Price, Size Tokens, Size USD, Side, Timestamp IST, Start Position, Direction, Closed PnL, Transaction Hash, Order ID, Crossed, Fee, Trade ID, Timestamp)
- Notes: No missing values. Date-time columns converted to datetime format for aggregation.

2.2 Market Sentiment Data

- Source: Fear & Greed Index
- Rows: 2,644
- Columns: 4 (timestamp, value, classification, date)
- Notes: Sentiment simplified to **Fear** or **Greed** for easier analysis.

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3. Data Cleaning and Preprocessing

1. Converted date/time columns to *datetime* objects for accurate time-based analysis.
2. Aggregated trader data by date to compute daily metrics:
    - Total number of trades
    - Total trading volume in USD
    - Average PnL per trade
    - Average trade size in tokens
    - Buy/Sell ratio
3. Simplified sentiment classification:
    - *Fear* + *Extreme Fear* → *Fear*
    - *Greed* + *Extreme Greed* → *Greed*
4. Merged trader metrics with sentiment data by date.

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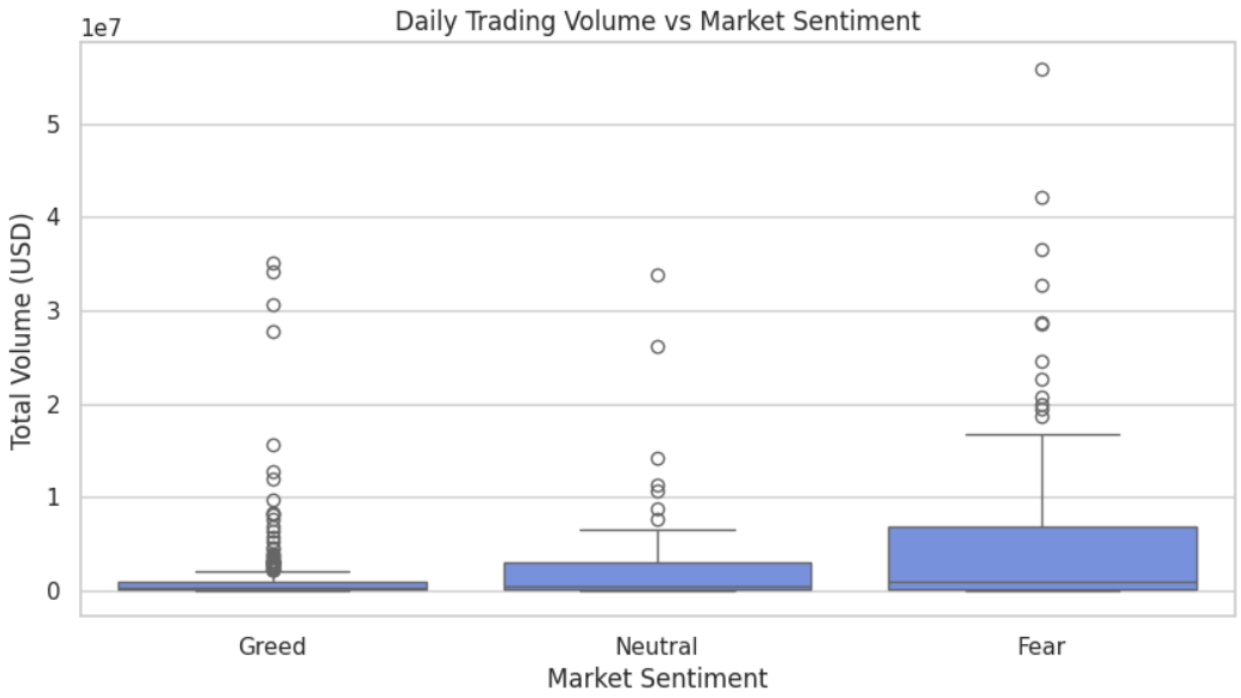
4. Exploratory Data Analysis (EDA)

4.1 Trading Volume vs Market Sentiment

A boxplot was created to compare daily trading volume under Fear vs Greed conditions.

Observations:

- Trading volume is significantly higher during Fear conditions, with the median and upper quartile values substantially elevated compared to other sentiments. Fear days show the widest distribution and highest outliers.
- Greed days display the lowest trading volumes, with a compact distribution near the baseline and minimal variation.
- Neutral sentiment falls between the two, showing moderate volume levels with some spread but fewer extreme values than Fear conditions.

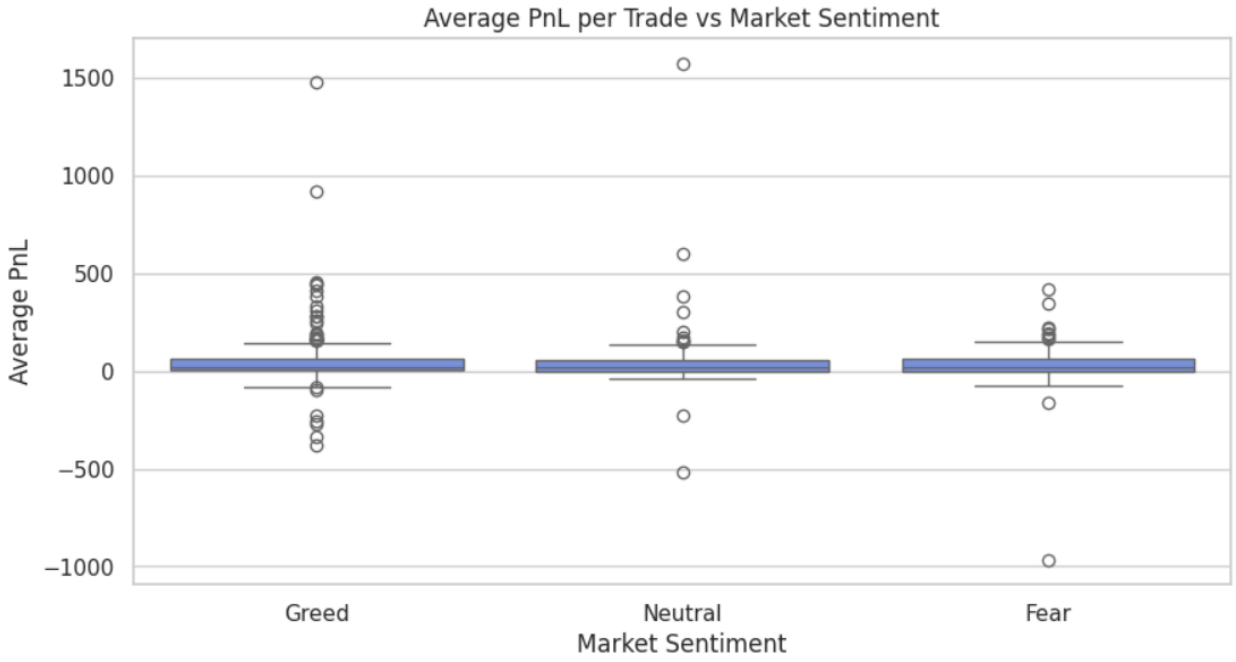


4.2 Average Profit (PnL) per Trade vs Market Sentiment

The average profitability per trade was compared under different sentiments.

Observations:

- Average PnL across all three sentiment categories shows relatively similar distributions, with median values hovering around zero for Greed, Neutral, and Fear conditions.
- All three sentiments exhibit comparable variance and outlier patterns. Greed and Neutral show both positive outliers (up to approximately 1500) and negative outliers (down to -500), while Fear displays similar spread with outliers reaching around 450 on the positive side and -1000 on the negative side.
- The boxplots reveal no strong differentiation in profitability patterns based on market sentiment, suggesting that PnL performance remains fairly consistent regardless of whether the market is in Greed, Neutral, or Fear mode.

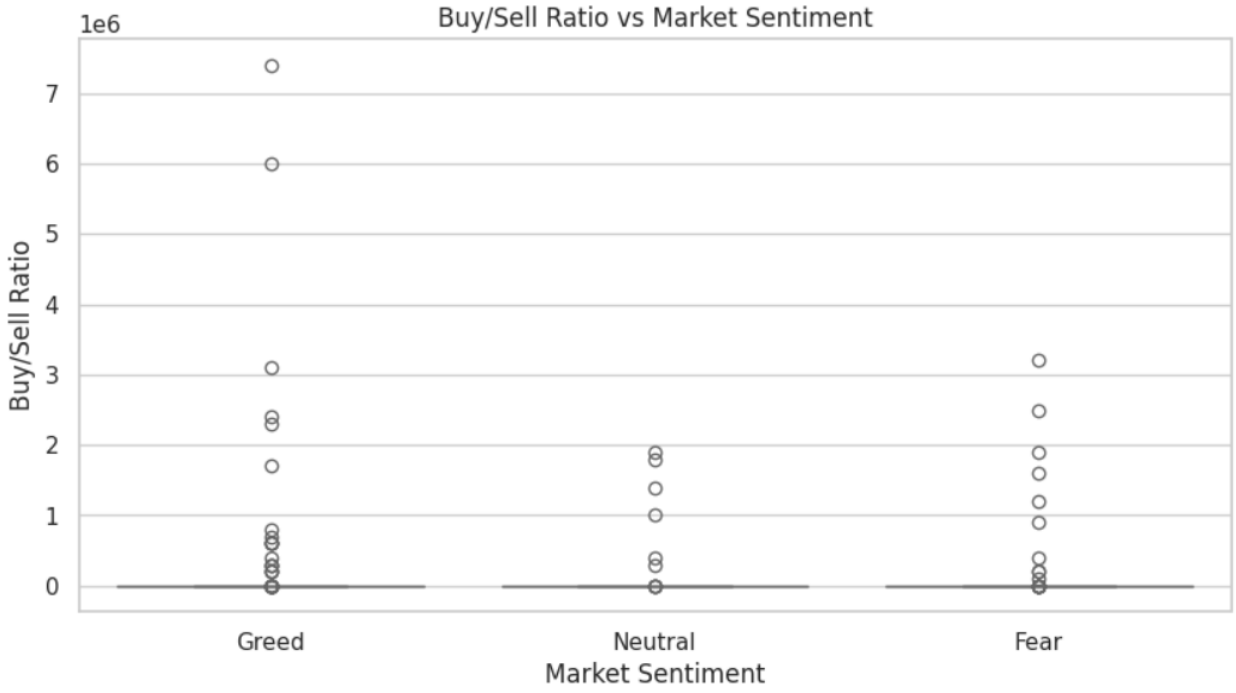


4.3 Buy/Sell Ratio vs Market Sentiment

The ratio of BUY to SELL trades was analyzed for each sentiment.

Observations:

- All three sentiment categories show buy/sell ratios clustered very close to zero, with median values nearly identical across Greed, Neutral, and Fear conditions.
- Greed sentiment displays the highest outliers, indicating occasional periods of very heavy buying activity despite the generally balanced median.
- Fear and Neutral conditions show more moderate outlier distributions compared to Greed.



4.4 Top Profitable Traders

The analysis identified the **top 10 traders** by total profit (Closed PnL).

Observations:

- A small set of traders consistently achieve higher profitability, indicating the importance of experience and strategy.
- High-performing traders maintain stable profits across both Fear and Greed market conditions.

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5. Insights & Key Takeaways

1. **Trading Volume is Sentiment-Dependent:**
    - Market sentiment significantly influences trading volume, with Fear conditions driving substantially higher trading activity compared to Greed or Neutral periods.
2. **Profitability Shows Limited Sentiment Impact:**
    - Average PnL remains fairly consistent across all sentiment categories, with similar median values and variance. This suggests that profitability is not strongly dependent on whether the market is in Fear, Neutral, or Greed mode.
3. **Buy/Sell Behavior Varies by Sentiment:**
    - While median buy/sell ratios are similar across sentiments, Greed days show the most extreme buying outliers, indicating occasional bursts of aggressive buying activity during high-confidence periods.
4. **Volume Spikes During Fear:**
    - The most notable pattern observed is the dramatic increase in trading volume during Fear conditions, likely driven by heightened market activity, position adjustments, and increased volatility responses.

These findings could inform risk management practices and trading strategies by recognizing that volume surges during fearful market conditions, while profitability patterns remain relatively stable regardless of sentiment.

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6. Conclusion

This study analyzed the relationship between Bitcoin trader behavior and market sentiment. The results indicate that market sentiment has a significant impact on trading volume, with Fear conditions driving substantially higher activity levels than Greed or Neutral periods. However, profitability patterns and buy/sell ratios showed relatively consistent distributions across sentiment categories, suggesting that these metrics are less directly influenced by whether the market is fearful or greedy.

The analysis is fully reproducible using the provided notebooks and CSV datasets, with visualizations saved for reporting purposes.

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7. Appendix

- The Python notebook (*notebook_1.ipynb*) include full code for data cleaning, aggregation, and visualization.
- All plots are saved in the *outputs/* folder.
- CSV datasets used are stored in the *csv_files/* folder.