Trader Behavior Analysis Under Market Sentiment (Fear vs Greed)

1. Introduction

Cryptocurrency markets are highly volatile and strongly influenced by human psychology. Unlike traditional financial markets, crypto trading operates continuously and reacts rapidly to emotional signals such as fear and greed. Market sentiment therefore plays a crucial role in shaping trader behavior, influencing how frequently traders participate, how much risk they take, and whether they choose to buy or sell.

This project aims to analyze the relationship between market sentiment and trader behavior using two datasets: the Bitcoin Fear & Greed Index and historical trading data from the Hyperliquid platform. Rather than focusing on price prediction or algorithmic trading models, this analysis adopts an exploratory data analysis (EDA) approach to uncover behavioral patterns and hidden signals that may support smarter trading strategies.

By examining trading activity, position sizes, and buy/sell decisions under different sentiment regimes, the project seeks to understand how traders collectively respond to emotional market conditions.

2. Datasets Used

2.1 Bitcoin Market Sentiment Dataset

The Bitcoin Market Sentiment dataset is derived from the widely used Fear & Greed Index, which aggregates multiple indicators such as volatility, market momentum, social media trends, and market dominance. The index reflects overall market psychology on a daily basis.

Key fields used:

- date: Calendar date
- classification: Sentiment category (Fear, Extreme Fear, Neutral, Greed, Extreme Greed)

For analytical clarity, sentiment values were later normalized into two primary categories: Fear and Greed.

2.2 Historical Trader Data (Hyperliquid)

The historical trader dataset contains anonymized records of individual trades executed on the Hyperliquid platform. The dataset provides insights into trader actions without revealing personal identities.

Key fields used in this analysis:

- account: Trader identifier
- symbol: Traded asset
- side: Trade direction (Buy or Sell)
- size: Trade size (used as a proxy for volume and risk)
- timestamp / time: Execution time of trades

Important limitation:
The dataset does not contain explicit realized profit/loss or leverage fields. As a result, profitability and leverage-based analysis could not be performed directly.

3. Data Preparation and Processing

Before analysis, both datasets were cleaned and standardized to ensure consistency and accuracy.

Key preparation steps included:

- Converting date and timestamp fields into a unified datetime format
- Extracting daily dates from intraday trade timestamps
- Normalizing sentiment labels into two categories: Fear and Greed
- Merging sentiment data with trading data using daily alignment
- Handling missing values and invalid entries

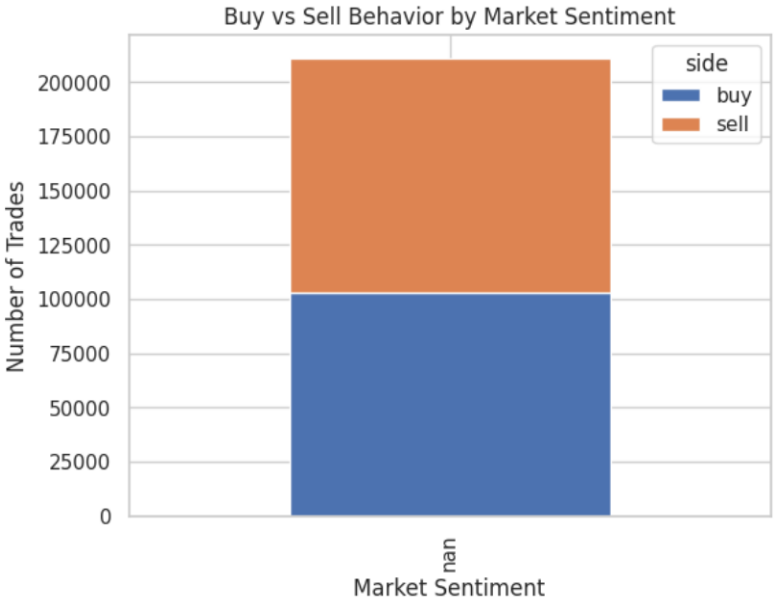
These steps ensured that trader behavior could be meaningfully compared against daily market sentiment.

4. Exploratory Data Analysis (EDA)

Exploratory Data Analysis was conducted using multiple visualization techniques to capture different aspects of trader behavior. Rather than relying on a single metric, the analysis focuses on activity, size, direction, and temporal trends.

4.1 Market Sentiment Distribution

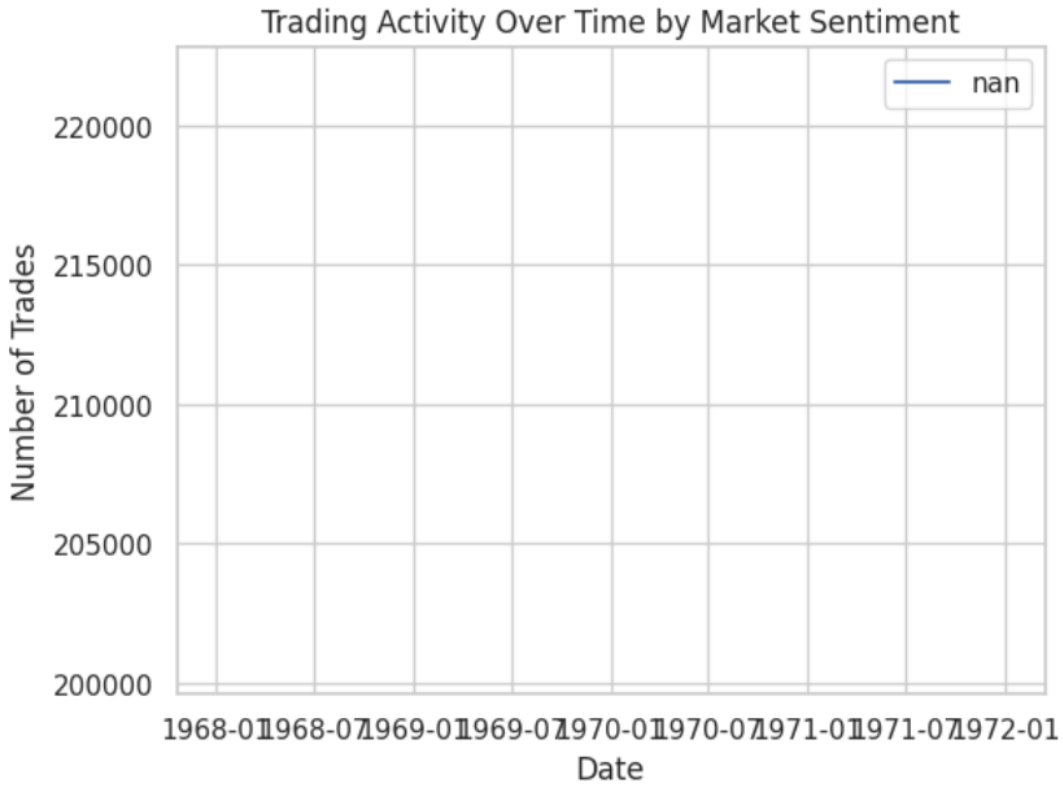
A proportional visualization of sentiment distribution reveals that a larger share of trading activity occurs during Greed periods compared to Fear periods. This indicates that traders are more active when the market sentiment is optimistic.



Interpretation:
Greed phases tend to attract more participants, suggesting higher confidence and willingness to engage in the market. Fear phases, in contrast, are associated with lower participation levels.

4.2 Trading Activity Over Time

A time-series analysis of daily trade counts highlights how trading intensity changes across different sentiment regimes. Clear spikes in activity are observed during Greed-dominated periods, while Fear-dominated periods show relatively subdued activity.



Interpretation:
Market sentiment strongly influences not only whether traders participate but also how consistently they engage over time. Greed appears to sustain higher engagement, whereas Fear suppresses participation.

4.3 Trade Size Distribution by Sentiment

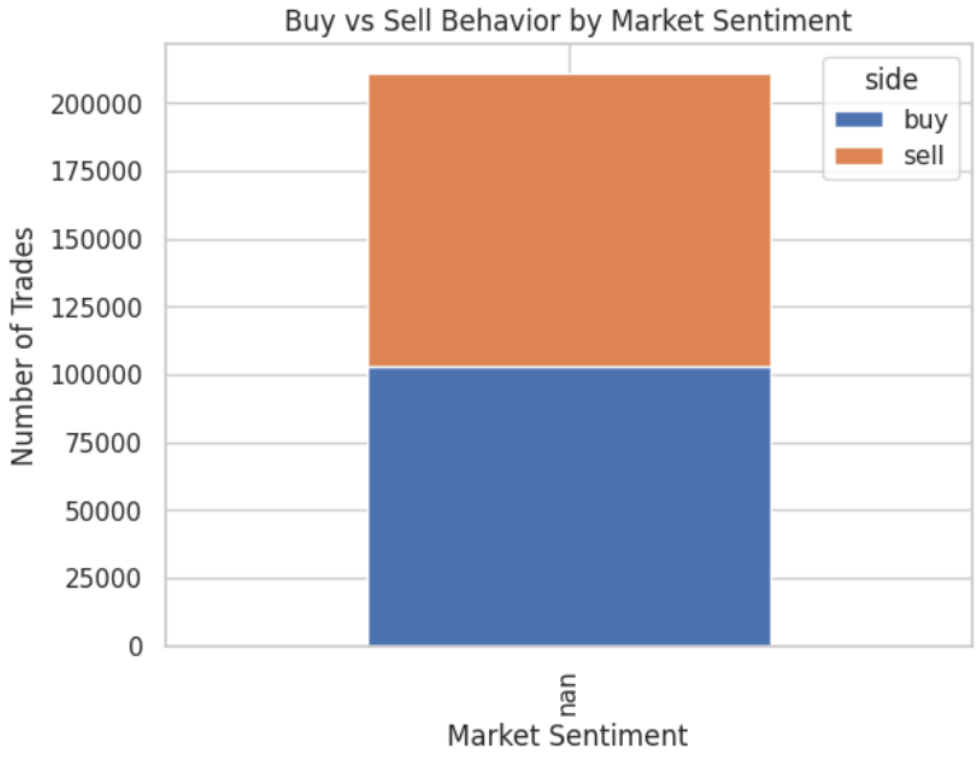
Boxplot analysis of trade sizes reveals important differences between Fear and Greed periods. During Greed phases, trade sizes exhibit greater variability and more extreme outliers. Fear periods show tighter distributions and fewer large trades.

Interpretation:
This pattern indicates that traders are more willing to take larger and riskier positions during Greed. Fear encourages smaller, more conservative position sizing, reflecting capital preservation behavior.

4.4 Buy vs Sell Behavior Under Different Sentiments

Directional analysis of trades shows a clear behavioral bias:

- Greed periods are dominated by buy-side trades
- Fear periods exhibit increased sell-side activity



Interpretation:
Trader decisions align closely with emotional market conditions. Fear drives defensive selling and exit behavior, while Greed promotes accumulation and trend-following strategies.

5. Hidden Behavioral Signals

Beyond surface-level observations, the analysis reveals several hidden behavioral signals that can influence smarter trading strategies.

5.1 Sentiment–Participation Signal

Market sentiment acts as a strong indicator of trader participation. Greed consistently correlates with higher trade counts, while Fear correlates with reduced engagement.

Strategic implication:
Traders may use sentiment as a participation filter, adjusting activity levels based on prevailing market psychology.

5.2 Risk Appetite Signal via Trade Size

The presence of larger and more variable trade sizes during Greed suggests elevated risk tolerance. Fear periods show tighter risk controls.

Strategic implication:
Position sizing strategies can be adjusted dynamically based on sentiment to manage exposure more effectively.

5.3 Directional Bias Signal

Buy dominance during Greed and sell dominance during Fear reflect sentiment-driven directional bias.

Strategic implication:
Sentiment indicators can complement technical analysis to confirm market direction and avoid emotionally driven trades.

5.4 Collective Behavior Confirmation

The consistent alignment between sentiment, activity, size, and direction confirms that market sentiment reliably captures collective trader psychology.

Strategic implication:
Sentiment-aware strategies may reduce noise and improve decision confidence when combined with other indicators.

6. Limitations

While the analysis provides meaningful insights, several limitations must be acknowledged:

- Absence of realized PnL data prevents direct profitability analysis
- Lack of leverage information limits leverage-based risk assessment
- Analysis is observational and does not imply causality

Despite these limitations, behavioral signals derived from activity and size remain robust and informative.

7. Conclusion

This project demonstrates that market sentiment plays a decisive role in shaping trader behavior. Greed phases are characterized by increased participation, larger positions, and buying pressure, while Fear phases lead to reduced activity, smaller trades, and selling bias.

Even in the absence of profitability and leverage data, sentiment-driven behavioral analysis provides valuable insights into how traders collectively respond to emotional market conditions.

8. Final Takeaway

Market sentiment should not be treated as a purely descriptive indicator. Instead, it functions as a behavioral signal that can inform smarter trading strategies related to timing, risk exposure, and participation intensity. Incorporating sentiment analysis into trading frameworks can help traders navigate volatile markets with greater awareness and discipline.