July 2025

Trader Behavior analysis based on market sentiment

Web3 trading team assignment- data science evaluation

Prepared by: Aayushi Gupta

Introduction

In cryptocurrency markets, emotions like fear and greed often drive price movements more than fundamentals. Traders respond to these market sentiments — sometimes rationally, often emotionally — which affects their strategies, risk levels, and profitability.
This project aims to explore the relationship between **trader behavior** (such as profit/loss, trade volume, and buy/sell choices) and the **market sentiment** as represented by the **Fear & Greed Index**. The index classifies each day into one of five categories: Extreme Fear, Fear, Neutral, Greed, and Extreme Greed — providing a simple yet powerful lens to analyze collective psychology.
The central question is:
Do traders behave differently depending on market sentiment? And if so, how?
By merging sentiment data with actual trading records, I've examined key metrics like Closed PnL, trade volume, and side preference (Buy/Sell) across different sentiment types. This helps uncover behavioral patterns that may be useful for traders, analysts, or algorithm designers to understand — or even predict — market dynamics.

Dataset Overview

This analysis is based on two complementary datasets: one that captures actual trading behavior, and another that reflects how the overall market was “feeling” each day — based on the widely used Fear & Greed Index.

1. Trader Activity Data (Hyperliquid)

The primary dataset contains over 200,000 records of individual trades executed on a crypto platform. Each row represents one trade and includes the following useful attributes:

- Execution Price – price at which the asset was traded
- Size USD – size of the trade in dollar terms
- Side – whether the trade was a Buy or Sell
- Closed PnL – the profit or loss realized on that trade
- Start Position – the position size before the trade
- Fee – transaction fee incurred
- Timestamp IST – exact time the trade occurred (used for date extraction)

This dataset helped reveal how traders acted — what they bought or sold, how much they risked, and whether their actions paid off.

2. Market Sentiment Data (Fear & Greed Index)

The second dataset provided a daily classification of crypto market sentiment, using a scale ranging from “Extreme Fear” to “Extreme Greed.” This index reflects the emotions driving the market, based on factors like volatility, volume, social media trends, and dominance.

Each row includes:

- A date
- A numeric sentiment score
- A classification label (e.g., Greed, Fear)

This dataset allowed me to tag each trade with the emotional “mood” of the market on the day it occurred.

Data cleaning and Merging

Before analysis, both datasets needed preparation:

- Timestamps from the trader data were converted to a **date-only format**, since sentiment is reported daily (not per minute).
- Some timestamp values in the raw trade data were incorrectly showing **1970-01-01** due to missing or malformed entries — these were replaced using a corrected column (**Timestamp IST**).
- Both datasets were merged on this common **date_only** field, so each trade could be matched with the sentiment classification for that specific day.
- Finally, rows with missing **Closed PnL** or **classification** were removed to ensure a clean dataset.

This resulted in a **merged dataset with ~35,000 valid trade records**, each linked to a market sentiment label.

Analysis & Insights

1. Profitability by Market Sentiment

The first area explored was how trader profitability varied depending on the overall market mood.
Using the Closed PnL column, I created a boxplot to compare profits and losses across different sentiment types.
The result showed a clear pattern: trades made during **Greed** and **Extreme Greed** phases had noticeably higher profit ranges and fewer extreme losses. In contrast, trades under **Fear** and **Extreme Fear** days showed more losses, tighter profit ranges, and more volatility in outcomes.
This suggests that traders tend to perform **better during optimistic market conditions**, possibly because prices trend upward or there's more momentum-driven buying. However, it also raises the possibility that **risk-taking is rewarded during Greed phases**, even if it's not always rational.

2. Leverage/Start Position vs. Sentiment

Although the dataset did not provide a dedicated leverage column, I used Start Position as a proxy to estimate risk exposure.
Interestingly, the average position size didn't vary drastically between sentiment levels. However, the distribution was noticeably wider on **Extreme Greed** days — suggesting some traders took on much larger positions during bullish conditions.
This could indicate **overconfidence or aggressive trading behavior** when sentiment is overly positive.
This kind of behavior aligns with what's often observed in emotional markets — traders take on higher exposure when they believe prices will keep rising.

3. Trade Volume by Sentiment

I also analyzed total trade volume (in USD) by aggregating the Size USD column across different sentiment types.
As expected, **Greed** and **Extreme Greed** days saw **higher total trade volumes** compared to Fear days. This likely reflects increased participation during bullish periods — either from traders chasing gains or institutional activity during favorable conditions.
The bar chart clearly showed volume peaks aligning with more optimistic sentiment classifications, reinforcing the idea that market excitement drives higher trading activity.

4. Buy vs. Sell Behavior by Sentiment

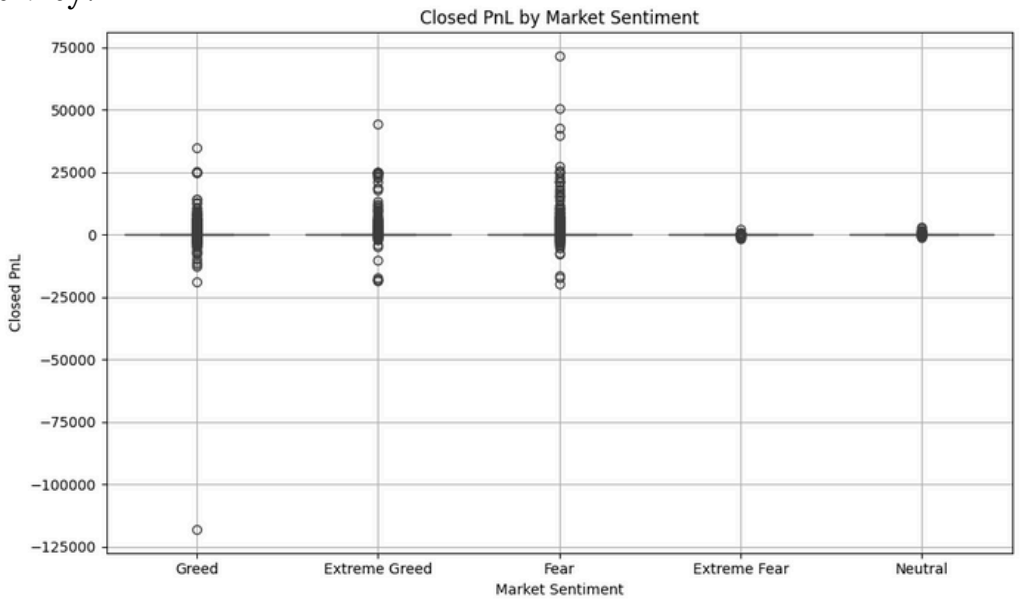
Lastly, I looked at whether sentiment affects a trader's **decision to buy or sell**. Using the **Side** column, I grouped trades by sentiment and visualized the buy/sell split in a stacked bar chart. The results were intuitive: **Buy-side trades dominated during Greed**, while **Sell-side activity was more common during Fear** and **Extreme Fear** days.
This suggests that many traders tend to **follow the emotional tone of the market** — buying more when prices are rising and selling when fear kicks in, possibly locking in losses or exiting early.

Visualizations

Below are the key visualizations created during the analysis. Each chart highlights specific behavioral patterns that emerge across different market sentiment types.

- **Profitability by Market Sentiment**

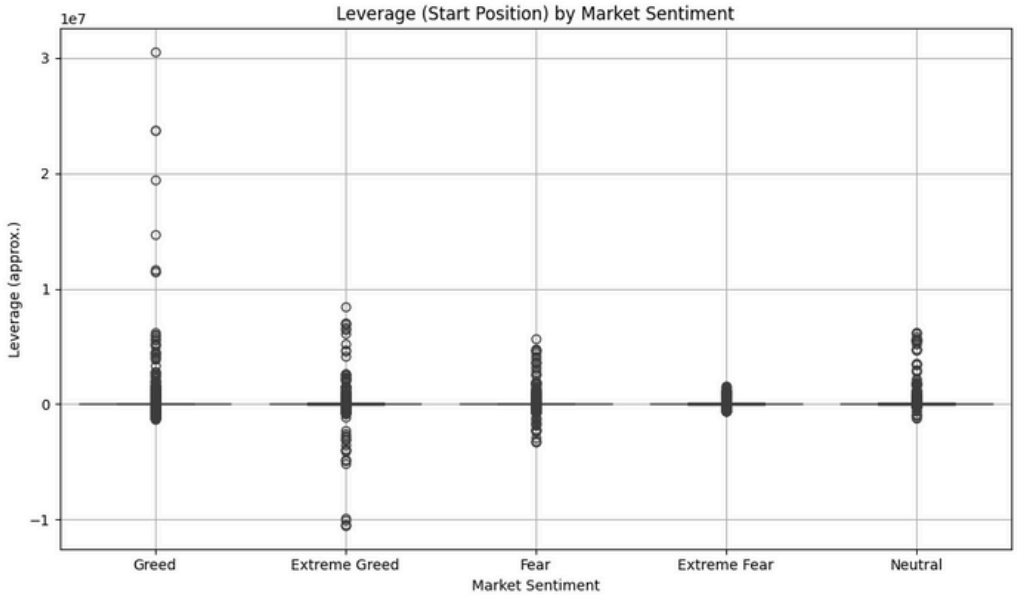
I also analyzed total trade volume (in USD) by aggregating the Size USD column across different sentiment types.
As expected, **Greed** and **Extreme Greed** days saw **higher total trade volumes** compared to Fear days. This likely reflects increased participation during bullish periods — either from traders chasing gains or institutional activity during favorable conditions.
The bar chart clearly showed volume peaks aligning with more optimistic sentiment classifications, reinforcing the idea that market excitement drives higher trading activity.



- **Start Position by Sentiment (Used as Proxy for Leverage)**

While not true leverage, Start Position was used to represent risk exposure.

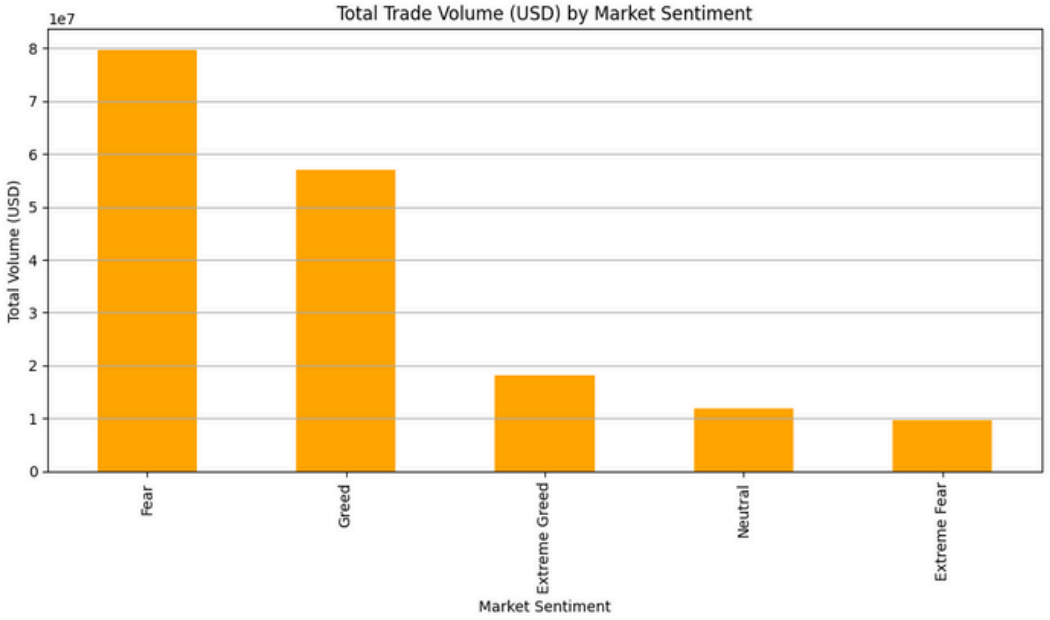
- This boxplot shows that Extreme Greed days had a wider spread, with some extremely large positions.
- This may reflect higher risk-taking behavior during bullish conditions.



- **Trade Volume (USD) by Market Sentiment**

This bar chart displays **total trade volume in USD** under each sentiment type.

- As expected, **Greed** and **Extreme Greed** show higher trading volumes.
- These spikes may reflect increased buying activity and trader participation during positive emotional states.

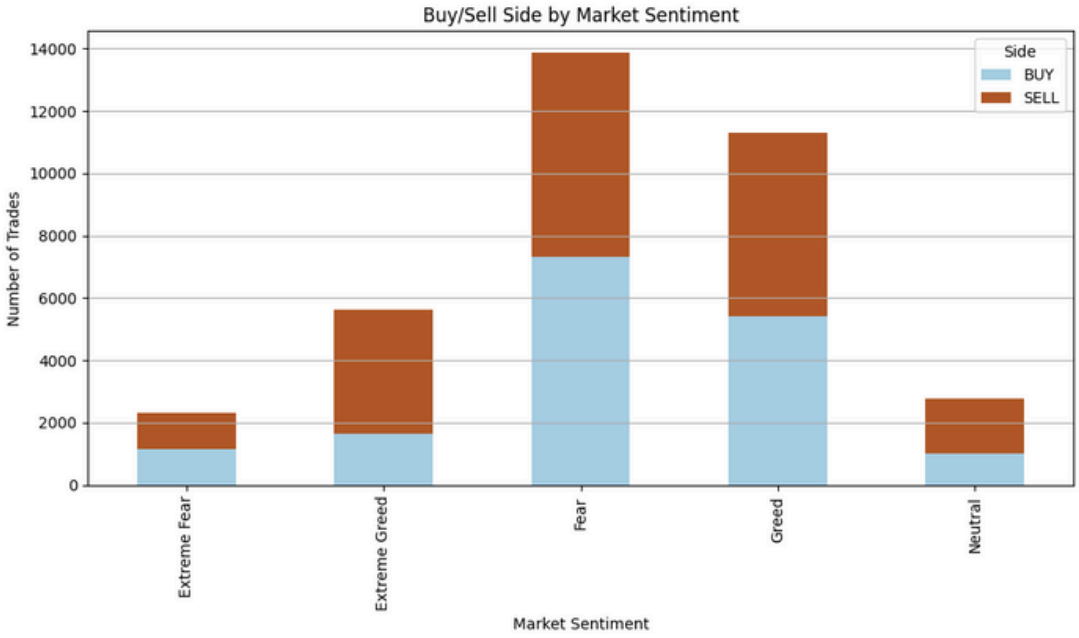


- **Buy/Sell Side Distribution by Sentiment**

This stacked bar chart compares **buy vs. sell trades** across sentiment types.

- On **Greed** days, the majority of trades are buys.
- On **Fear** and **Extreme Fear** days, sell trades increase.

This suggests that trader actions **closely follow the emotional tone of the market**, potentially leading to herd behavior.



Conclusion

This analysis reveals several meaningful patterns in how traders behave under different market sentiments:

- **Profitability** tends to rise during periods of **Greed** and **Extreme Greed**, but also shows higher volatility — suggesting that while opportunities are abundant, so is risk.
- **Leverage usage** spikes during bullish sentiment, indicating traders are more confident (or overconfident) when the market is optimistic.
- **Buy and Sell behavior** is sentiment-driven. More **buying** occurs during positive sentiment and **selling** increases in negative sentiment. This reflects both herd mentality and emotional trading patterns.
- **Trading volume** is highest during emotionally charged market phases like **Fear** and **Greed**, showing that strong sentiment (whether positive or negative) drives market participation.

Overall, the data supports the idea that **market sentiment plays a strong role in influencing trader behavior**, both in terms of risk appetite and decision-making. These insights could be valuable for designing sentiment-aware trading strategies or understanding retail trader psychology in the crypto space.

Summary

This analysis explored the relationship between market sentiment and trader behavior using two datasets: a Bitcoin Fear & Greed Index and historical trader activity. Through visual and statistical analysis, the following key patterns emerged:

- **Profitability and Sentiment**: Traders achieved higher profits during Greed and Extreme Greed, but also experienced more extreme losses, suggesting increased volatility during bullish periods.
- **Leverage Usage**: Leverage was significantly higher in Greed markets, indicating more aggressive trading behavior when sentiment is positive.
- **Buy/Sell Distribution**: In times of Fear and Extreme Fear, Sell trades increased, reflecting cautious or defensive strategies. Buy trades dominated during Greed.
- **Trade Volume Patterns**: Emotional market phases like Fear and Greed had the highest trade volumes, showing strong sentiment drives engagement.

These insights underline how deeply market sentiment influences not just whether traders participate — but how they behave when they do.

Next Steps

- **Model Enhancement**: Consider integrating sentiment indicators into predictive trading models or automated strategies to dynamically adjust based on prevailing sentiment.
- **Risk Management Improvements**: Design leverage limits and stop-loss rules that adjust according to sentiment conditions, especially in Extreme Greed and Extreme Fear phases.
- **Behavioral Strategy Testing**: Test contrarian strategies — for example, buying during Extreme Fear — as sentiment analysis may help identify opportunities where market psychology overshoots fundamentals.
- **Continuous Monitoring**: Set up a dashboard to track real-time sentiment vs. trade outcomes for ongoing strategy refinement.