Data Science Report

Analysis of Trader Behavior vs Market Sentiment (Fear & Greed)

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1. Introduction

Financial markets are heavily influenced by human psychology. Emotions such as fear and greed often drive irrational trading decisions, impacting risk exposure, trade volume, and profitability.
This project analyzes the relationship between **Bitcoin market sentiment (Fear & Greed Index)** and **trader behavior** using historical trade data from the Hyperliquid platform.

The objective is to understand how **profitability, risk-taking, and trading activity** change under different market sentiment conditions and to identify actionable insights for smarter trading strategies.

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2. Dataset Overview

2.1 Bitcoin Market Sentiment Dataset

This dataset captures daily market sentiment derived from the Fear & Greed Index.

Key Columns:

- date: Calendar date

- classification: Market sentiment category (Fear, Extreme Fear, Greed, Extreme Greed)

This dataset helps quantify market psychology on a daily basis.

2.2 Historical Trader Dataset (Hyperliquid)

This dataset contains detailed trade-level information from cryptocurrency traders.

Key Columns Used:

- Timestamp: Trade execution time (epoch milliseconds)

- Side: Buy / Sell

- Direction: Trade direction

- Size USD: Trade volume in USD

- Execution Price: Price at which trade was executed

- Closed PnL: Profit or loss from completed trades

- Account: Trader identifier

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3. Data Preprocessing

Several preprocessing steps were applied before analysis:

1. **Timestamp Conversion**
   Trader timestamps were converted from epoch milliseconds to calendar dates.

2. **Date Alignment**
   Both datasets were aligned using a common date column to enable accurate merging.

3. **Dataset Merge**
   The trader dataset was merged with the sentiment dataset using an inner join on date, ensuring that each trade was associated with the correct market sentiment.

4. **Data Validation**

   o No missing values were found in the final merged dataset.

   o Column names were standardized to avoid case-sensitivity issues.

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4. Exploratory Data Analysis & Key Findings

4.1 Trading Volume vs Market Sentiment

Average trade size (USD) was analyzed across sentiment categories.

Observation:

- Trade volumes are significantly higher during **Greed** periods.

- During **Fear**, traders reduce position sizes, indicating cautious behavior.

Insight:
Greed-driven markets encourage aggressive capital deployment, while fear leads to conservative position sizing.

4.2 Profitability vs Market Sentiment

Average Closed PnL was compared across different sentiment states.

Observation:

- Greed periods show higher volatility in profits.

- Fear periods generally exhibit lower losses and more controlled outcomes.

Insight:
Although greed can result in higher profits, it also increases downside risk. Fear-driven trading tends to preserve capital.

4.3 Buy vs Sell Behavior

Trade direction distribution was analyzed under each sentiment category.

Observation:

- Greed periods show a higher proportion of **BUY** trades.

- Fear periods display increased selling pressure or reduced trade participation.

Insight:
Market optimism leads to buying dominance, while fear results in defensive or exit-driven behavior.

4.4 Risk Behavior and Trade Frequency

Trade frequency across sentiment categories was evaluated.

Observation:

- Trade frequency increases significantly during Greed.

- Fear periods show reduced trading activity.

Insight:
Greed is associated with overtrading, while fear causes traders to step back from the market.

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5. Visual Analysis

A bar chart comparing **Average Closed PnL vs Market Sentiment** was generated to visually support the findings.

This visualization highlights:

- Higher profit volatility during Greed

- Risk containment during Fear-driven periods

(Refer to outputs/pnl_vs_sentiment.png)

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6. Actionable Trading Signals

Based on the analysis, the following strategic insights can be derived:

1. **Position Sizing Strategy**
   Reduce trade size during extreme greed to avoid overexposure.

2. **Risk Management**
   Greed periods require tighter stop-loss strategies due to higher volatility.

3. **Opportunity Identification**
   Fear periods may offer better risk-adjusted entry points due to reduced competition and lower leverage usage.

4. **Behavioral Awareness**
   Traders should actively monitor sentiment indicators to avoid emotion-driven decisions.

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7. Conclusion

This study demonstrates a strong relationship between market sentiment and trader behavior.
Fear leads to conservative, risk-aware trading, while greed encourages aggressive participation and higher volatility.

By integrating sentiment analysis into trading strategies, traders can improve decision-making, manage risk more effectively, and enhance long-term profitability.

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8. Future Scope

- Incorporating leverage data for deeper risk analysis

- Studying extreme sentiment conditions separately

- Applying machine learning models to predict trader performance based on sentiment