Trader Behavior Analysis Under Market Sentiment

Fear vs Greed in Bitcoin Markets

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Domain: Web3 / Crypto Trading Analytics

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1. Problem Statement

Financial markets are strongly influenced by collective human emotions such as fear and greed. In highly volatile markets like cryptocurrency, these emotional shifts can significantly affect trader behavior, risk-taking decisions, and profitability.

The objective of this project is to analyze how trader behavior and performance vary under different market sentiment regimes—specifically **Fear** and **Greed**—by combining real trade-level data with the Bitcoin Fear & Greed Index. The goal is to uncover behavioral patterns and trader characteristics that can support smarter trading strategies and risk management decisions.

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2. Datasets Used

This analysis uses two primary datasets:

2.1 Bitcoin Fear & Greed Index

- Provides daily market sentiment classifications
- Sentiment categories include: Extreme Fear, Fear, Neutral, Greed, Extreme Greed
- For this analysis, sentiment was consolidated into two regimes:
    - **Fear:** Fear + Extreme Fear
    - **Greed:** Greed + Extreme Greed

Neutral days were excluded from direct comparison to maintain interpretability.

2.2 Historical Trader Data (Hyperliquid)

- Trade-level execution data from a Web3 trading platform
- Key attributes include:
    - Trader identifier (account)
    - Trade size (USD)
    - Trade direction (Buy / Sell)
    - Timestamp
    - Realized profit or loss (Closed PnL)

Each row represents a single executed trade.

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3. Methodology

The analysis followed a structured, multi-phase approach:

1. **Data Cleaning & Standardization**
    - Standardized column names and formats
    - Converted timestamps to datetime
    - Removed irrelevant blockchain metadata
2. **Time Alignment**
    - Extracted calendar date from trade timestamps
    - Aligned each trade with the corresponding daily market sentiment
3. **Sentiment Normalization**
    - Reduced multi-level sentiment into Fear vs Greed regimes
    - Ensured consistent comparison across periods
4. **Exploratory Data Analysis (EDA)**
    - Compared trade activity, profitability, and risk exposure under each sentiment
    - Visualized distributions and behavioral differences
5. **Trader-Level Analysis**
    - Aggregated performance metrics per trader
    - Compared individual trader behavior across sentiments

    - Identified consistent and sentiment-dependent traders
6. **Trader Archetype Classification**
    - Grouped traders based on risk exposure and performance
    - Analyzed how each archetype behaves under Fear and Greed

All outputs were saved in a standardized, reproducible directory structure.

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4. Key Findings

4.1 Aggregate Market Behavior

- Median realized profitability is approximately **zero** in both Fear and Greed regimes.
- Despite similar central tendencies, **Greed periods exhibit significantly higher downside risk**, with more extreme negative PnL outliers.
- Trade activity and average trade size increase during Greed, indicating heightened risk appetite.
- Fear regimes show comparatively more controlled position sizing and lower volatility.

4.2 Risk and Trade Size Behavior

- Trade size distributions are highly skewed, spanning multiple orders of magnitude.
- Large trades are substantially more frequent during Greed periods.
- Differences between Fear and Greed are most pronounced in the **upper tail**, not among typical trades.
- This suggests sentiment primarily influences **extreme risk-taking**, rather than everyday trading behavior.

4.3 Directional Trading Patterns

- Both Buy and Sell trades are active under all sentiment regimes.
- During Fear, Buy and Sell activity is relatively balanced.
- During Greed, Sell-side activity increases, suggesting profit-taking and position unwinding in optimistic markets.

- Sentiment affects **trade intensity and balance**, rather than enforcing a one-sided market bias.

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5. Trader-Level Insights

5.1 Performance Heterogeneity

- Trader performance varies significantly, indicating strong heterogeneity in strategy effectiveness.
- A small subset of traders accounts for a disproportionately large share of total profits.
- High total PnL does not necessarily correspond to high win rates, highlighting the importance of risk–reward balance.

5.2 Consistency Across Market Sentiment

- Several traders remain profitable in both Fear and Greed regimes, demonstrating **strategy robustness**.
- Some traders exhibit **Greed-dependent performance**, generating profits primarily during optimistic market conditions.
- Very few traders perform better exclusively during Fear regimes.

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6. Trader Archetypes

Traders were classified into intuitive archetypes based on average trade size and total profitability:

- **High-Risk High-Reward**
    - Large trade sizes and high volatility
    - Generate the highest total PnL
    - More sensitive to sentiment-driven risk amplification
- **Moderate Traders**
    - Balanced trade sizes and steady performance
    - Form the largest trader group
    - Benefit most during Greed periods through increased activity
- **Consistent Losers**

- Persistently negative performance
- Often maintain reasonable win rates but poor risk management
- Slight improvement during Greed, but remain unprofitable overall

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6.1 Archetypes vs Market Sentiment

- High-Risk High-Reward traders generate a significant portion of profits during Fear, despite lower trade volume.
- During Greed, these traders increase exposure but experience diminishing marginal returns.
- Moderate traders expand both trade volume and profitability during Greed.
- Market sentiment amplifies existing trader behavior rather than fundamentally changing trading styles.

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7. Business Implications

- **For Traders**
  - Risk exposure should be carefully controlled during Greed periods to limit downside losses.
  - Consistency across sentiment regimes is a stronger indicator of long-term success than short-term gains.
- **For Trading Platforms**
  - Sentiment-aware risk controls (e.g., leverage or size warnings) can reduce extreme losses.
  - Trader segmentation based on behavioral archetypes can improve monitoring and capital allocation.
  - Identifying consistent traders can support incentive and trust mechanisms.

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8. Limitations

- The analysis is based on a limited number of highly active traders, which may not represent the broader market.
- Market sentiment data is available at daily resolution, while trades occur intraday.

- Leverage, liquidation events, and external market factors were not explicitly modeled.
- Results reflect historical behavior and may not generalize to future market conditions.

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9. Conclusion

This project demonstrates that while average profitability appears similar across Fear and Greed regimes, market sentiment significantly influences trader risk-taking behavior, loss severity, and performance consistency. Individual trader discipline and risk management play a far greater role in long-term success than sentiment alone. By integrating behavioral insights with market sentiment, trading strategies and platform-level risk management can be meaningfully improved.