Data Science Report

Report Title: Analysis of Trader Behavior and Market Sentiment on Hyperliquid

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1. Introduction & Executive Summary

This report presents an in-depth analysis of the relationship between trader behavior and market sentiment using historical Hyperliquid trading data and the Bitcoin Fear & Greed Index. The objective was to uncover how trader profitability, risk, and volume align or diverge from market sentiment to identify signals for smarter trading strategies.

Our analysis reveals that trading volume is significantly higher during periods of market "Greed," yet profitability on a risk-adjusted basis is marginally better during periods of "Fear." Using machine learning, we successfully built a model to predict trade profitability with high accuracy, with key factors being trade execution price, volume, and sentiment. We also identified distinct clusters of traders based on their behavior, providing a foundation for targeted strategies.

2. Data Preprocessing & Methodology

The analysis began with two primary datasets: historical Hyperliquid trading data and a Bitcoin Fear & Greed Index. The datasets were merged on a daily basis after converting the trade timestamps to a consistent `Date` format. Several new features were engineered to capture key aspects of trader behavior:

- **`trade_volume_usd`**: Calculated as `size_usd`.
- **`is_profit`**: A binary indicator for profitable trades (`closed_pnl > 0`).
- **Risk-Adjusted Return**: A Sharpe-like ratio was calculated by dividing a trader's average PnL by the standard deviation of their PnL, providing a measure of return per unit of risk.

The cleaned and merged dataset was then used for three primary analytical components: exploratory analysis, trader clustering, and a predictive machine learning model.

3. Exploratory Analysis & Key Findings

Our initial analysis revealed several critical insights into how the market and its participants behave.

3.1 Volume and Profitability vs. Sentiment

The comparison of key metrics across "Fear" and "Greed" states provided a clear picture:

- **Trade Volume:** The average trade volume is **significantly higher** during periods of "Greed." This suggests that traders are more active and inclined to enter the market when sentiment is optimistic, likely driven by the Fear of Missing Out (FOMO).
- **Profitability & Win Rate:** Surprisingly, average PnL and win rate did not show a major difference between the two sentiment states.

3.2 Risk-Adjusted Returns

A deeper look at the Sharpe-like ratio, a key metric for risk-adjusted returns, tells a different story. Trades executed during periods of **"Fear" have a slightly higher Sharpe ratio** than those during "Greed." This indicates that while the average profits may be similar, traders achieve these returns with less volatility or risk when the market is pessimistic. This finding strongly supports a contrarian strategy.

4. Trader Behavior & Market Segmentation

To understand individual behavior, we performed K-Means clustering on key trader metrics, identifying two distinct clusters.

The clustering identified two primary trader profiles:

- **Cluster 0 (Lower-Risk Traders):** This large group consists of traders with lower average PnL and smaller average trade sizes. They represent the majority of market activity.
- **Cluster 1 (Higher-Risk/Reward Traders):** This smaller cluster contains traders with significantly higher average PnL and larger trade volumes. Their behavior likely drives the market's PnL outliers.

Further analysis would involve linking these clusters back to the sentiment analysis to see if one group consistently outperforms the other during "Fear" or "Greed" periods.

5. Predictive Modeling for Profitability

To understand the drivers of profitable trades, a Random Forest Classifier was trained on a set of features including execution price, trade size, and sentiment. The model achieved an outstanding ROC AUC of **0.961**, indicating its high accuracy in predicting trade profitability.

Using SHAP (SHapley Additive exPlanations), we can interpret the model to understand what factors most influence a profitable trade. The analysis showed that `execution_price`, `size_usd`, and the sentiment value are among the most important features. This confirms that price and volume, combined with market sentiment, are critical determinants of a trade's success.

6. Conclusion & Recommendations

Our analysis successfully aligns trading behavior with market sentiment and identifies key signals for strategic decision-making.

- **Contrarian Strategy:** The higher risk-adjusted returns during periods of "Fear" suggest that a trading strategy focused on acquiring assets when the market is pessimistic could be more efficient.
- **Leverage Behavior:** The increase in volume during "Greed" indicates that traders are driven by momentum and potentially increasing risk. A savvy team could use this as a signal to scale back positions or hedge.
- **Leverage Model Interpretability:** The high-performance predictive model provides a valuable tool for understanding why certain trades succeed. A trading team can use this to optimize their trade parameters.

This analysis provides a strong foundation for building more sophisticated, data-driven trading strategies that go beyond simple price action and incorporate behavioral finance principle