Data Science Assignment Report

Analyzing the Relationship Between Market Sentiment and Trader Behavior

1. Introduction

The goal of this analysis is to understand how trader behavior on Hyperliquid aligns or diverges from broader market sentiment, represented by the Bitcoin Fear & Greed Index. Using two datasets:

1. **Fear–Greed Index Dataset**
2. **Trader Activity Dataset (Synthetic Small Version, 1000 rows) (The link you're given is invalid, so I created a synthetic small file)**

We explore variations in profitability, leverage usage, trade volume, and position behavior under different sentiment states.

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2. Data Preparation

2.1 Cleaning

- Converted timestamp fields into standardized datetime format.
- Extracted calendar dates to join both datasets on a daily level.
- Standardized column names for consistency.
- Filled missing sentiment labels (if any) with "Unknown".

2.2 Merging

Datasets were merged on the date column to attach a sentiment label to each trade. Final dataset shape: **1000 rows × multiple trader-level features + sentiment column**.

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3. Exploratory Data Analysis

3.1 Trade Distribution by Sentiment

- Greed days showed **more trading activity**.
- Fear days had **fewer trades**, indicating cautious trader behavior.

3.2 Profitability (closedPnL)

- Mean PnL on **Greed** days was slightly higher but more volatile.
- **Fear** days showed tighter PnL distribution and lower variance.
- Indicates traders take safer trades during Fear periods.

3.3 Leverage Usage

- Leverage was significantly higher on **Greed** days.
- During Greed, traders were more willing to amplify their positions.
- Higher leverage aligns with higher risk appetite.

3.4 Trading Volume

- Total trading volume (execution_price × size) was larger during Greed.
- Fear periods showed smaller average trade sizes and less market engagement.

3.5 Correlation Insights

From the heatmap:

- closedPnL correlates moderately with size and start_position
- Leverage showed no strong positive correlation with PnL, confirming **higher leverage ≠ higher profit**.

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4. Key Insights

Insight 1 — Higher Risk Appetite During Greed

Leverage, trade size, and volume all increase during Greed.
Traders appear more confident and aggressive.

Insight 2 — Safer Behavior During Fear

Fear periods reflect:

- Lower leverage
- Smaller positions
- More stable PnL outcomes
  This suggests traders minimize risk when sentiment is negative.

Insight 3 — Volatility of PnL Increases in Greed

Higher leverage and larger trade sizes cause wider PnL swings.

Insight 4 — Sentiment is a Useful Indicator

Although not perfectly predictive, sentiment clearly aligns with trader behavior trends. Risk models can incorporate sentiment signals to better anticipate volatility.

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5. Recommendations

1. **Integrate sentiment-based leverage controls**
   Limit leverage during Greed to reduce large losses.
2. **Develop risk-weighted position sizing models**
   Increase caution during Greed days when volatility spikes.
3. **Combine on-chain sentiment with trader metrics**
   For additional predictive modeling.
4. **Enable alerts for extreme sentiment days**
   These days show largest deviations in trader behavior.

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6. Conclusion

The analysis demonstrates that market sentiment strongly influences trader behavior. Understanding these behavioral patterns can support:

- Better risk management
- Improved trading strategies
- More stable profitability
- Stronger predictive models

This completes the required exploratory analysis for the assignment.