

Data Science Assessment Report

Trader Behaviour Insights: Sentiment Alignment Analysis

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Target Role: Junior Data Scientist – Trader Behaviour Insights

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1. Executive Summary

This report analyzes the relationship between Hyperliquid trader activity and Bitcoin market sentiment (Fear vs. Greed). The analysis reveals a **strong, statistically significant contrarian signal** in trader behaviour. The most profitable and active trading occurs during periods of **Fear**.

Key Finding	Fear Days	Greed Days	Strategic Implication
Aggregate PnL	\$39,012 (Mean)	\$15,848 (Mean)	Contrarian Signal: Profitability is maximized by "buying into panic."
Total Volume (Risk Proxy)	\$5.69 Million (Mean)	\$1.35 Million (Mean)	Surge in Activity: Largest capital commitments occur when sentiment is lowest.
Net Trade Flow	~ \$5.57 Million	~ \$1.21 Million	Directional Bias: Extreme net selling pressure accompanies profitable Fear days.

2. Methodology and Data Pre-processing

The analysis was conducted using two datasets: the Bitcoin Market Sentiment Index (Classification: Fear/Greed) and high-frequency Historical Trader Data from Hyperliquid.

Data Preparation

1. The high-frequency trader data (historical_data.csv) was aggregated to **daily metrics** (Total PnL, Total Volume, Net Trade Flow, Trade Count) based on the Timestamp IST column.

2. The Sentiment Index was cleaned, grouping 'Extreme Fear' and 'Extreme Greed' into their respective 'Fear' or 'Greed' categories.
3. The daily trader metrics were joined with the daily sentiment data on the common **Date** column, resulting in the final analytical dataset, `daily_merged_data_for_analysis.csv`.

Data Limitation: Addressing Missing Leverage

The assignment required analysis of leverage as a risk indicator. As the column was unavailable in the provided data, we substituted this dimension of risk using the available proxies: **Total Daily Volume** and **Trade Count**. Higher values for these proxies are interpreted as increased risk appetite and capital commitment.

Statistical Method

An independent two-sample **T-test** (Welch's test) was applied to compare the means of trader behaviour metrics between the two sentiment groups (Fear vs. Greed).

3. Core Analytical Results

All four core metrics showed a statistically significant difference between Fear and Greed days ($P < 0.05$).

3.1 Profitability (Total Daily PnL)

The aggregate **Total Daily PnL** is significantly higher on **Fear days** (Mean $\sim \$39,012$) than on Greed days (Mean $\sim \$15,848$). This difference is statistically significant ($P = 0.025$). This confirms a **Contrarian Profitability** pattern, where high profitability is achieved when the market is pessimistic.

3.2 Risk Proxy: Volume and Activity

The trading community demonstrates a **counter-cyclical risk profile**.

- **Total Daily Volume** on Fear days ($\sim \$5.69$ Million) is **4.2 times larger** than on Greed days ($\sim \$1.35$ Million).
- **Trade Count** is **2.7 times higher** on Fear days, indicating a surge in trading activity and market depth when sentiment is low.

These findings suggest that **sophisticated capital enters the market during downturns** (Fear), demonstrating a high conviction contrary to the prevailing sentiment.

3.3 Directional Bias (Net Trade Flow)

On both Fear and Greed days, the aggregate **Net Trade Flow** is negative (net selling). However, the magnitude of net selling pressure is vastly different: the daily net outflow on Fear days ($\sim \$5.57$ Million) is **4.6 times greater** than on Greed days ($\sim \$1.21$ Million).

This suggests that the high profitability on Fear days is achieved despite overwhelming net selling pressure. The profitable trades are either **large, strategic buy orders absorbing the selling** or highly effective short-selling and covering strategies during peak volatility.

4. Strategic Insights and Trading Signals

Based on the divergence of trader behavior and market sentiment, the following strategic signals are derived:

Signal 1: The "Contrarian Fear Premium"

Strategy: Assign a **high-conviction weight** to the "Fear" classification in any automated trading model. Periods of high fear are not periods of retreat but rather periods of **peak activity and maximal aggregate profitability** for the tracked traders. This signal suggests that when the index flashes Fear, a strategic entry point is near.

Signal 2: Volatility/Liquidity Event Detection

Strategy: Use the **surge in Volume and Trade Count** as a secondary confirmation of a profitable trading environment. When sentiment is low and activity metrics are simultaneously spiking, it signals the entry of large, high-conviction capital, creating high-liquidity conditions suitable for executing large, strategic orders.

Signal 3: Net Flow for Exhaustion

Strategy: Monitor the magnitude of the negative **Net Trade Flow**. The extreme negative flow on Fear days may represent **seller exhaustion**. A potential strategic entry signal could be triggered not just by the 'Fear' classification, but by 'Fear' combined with a **sudden drop in the Net Trade Flow magnitude**, indicating the selling pressure has dissipated and the market is primed for a reversal.