# Data Science Assignment Report

## Trader Behavior vs. Market Sentiment

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## 1. Introduction

This report examines the relationship between trader behavior and market sentiment using two datasets: a historical record of trades from **Hyperliquid** and the **Bitcoin Fear & Greed Index**. The goal was to uncover correlations and hidden patterns that reveal how market mood influences trading activity, profitability, and risk.

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## 2. Methodology

The project followed a standard data science workflow, implemented in the accompanying Jupyter notebook (*notebook_1.ipynb*).

### Data Loading and Cleaning

- Both datasets were loaded and inspected.
- The trading dataset's `Timestamp` column (epoch milliseconds) was converted into UTC datetime.
- A consistent `Date` column was created in both datasets to enable daily-level comparisons.

### Daily Aggregation

Raw trade-level data was aggregated into daily summaries. For each trading day, the following metrics were calculated:

- **daily_pnl**: Total profit and loss across all trades.
- **daily_volume_usd**: Sum of all trade sizes in USD.
- **daily_trades**: Number of trades executed.
- **avg_fee**: Average transaction fee.

### Dataset Merging

- Daily statistics were merged with the Fear & Greed Index on the `Date` column.
- An inner join provided a clean set of overlapping days for primary analysis.

- A left join was also performed to retain all trading days, including one day with no corresponding sentiment data.

**Exploratory Data Analysis (EDA)**
Bar plots, scatter plots, correlation matrices, and summary tables were used to explore relationships between sentiment and trading behavior.

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## 3. Key Findings & Insights

**Finding 1: Inverse Relationship between Sentiment and Activity**
Market activity shows a negative correlation with sentiment values. Higher sentiment (greater "Greed") was linked to lower daily PnL, trading volume, and number of trades. Lower sentiment (greater "Fear") coincided with heightened activity.

**Finding 2: Fear as a Catalyst for Extreme Behavior**
Days classified as *Fear* stood out dramatically. One such day recorded the highest total daily PnL, trading volume, and number of trades in the dataset. This suggests that market fear — driven by panic or contrarian opportunity — intensifies trading behavior.

**Finding 3: Greed and Neutrality Signal Calm Markets**
Days labeled *Greed*, *Extreme Greed*, or *Neutral* were tightly clustered, showing consistently lower PnL, volumes, and trades. These regimes reflect relative market stability compared to Fear days.

**Finding 4: An Unclassified Anomaly (2025-06-15)**
A day without sentiment data showed unusually high trading volume (310M USD) but only moderate trades (~26k) and profitability (~71k USD). This profile does not align neatly with either Fear or Greed patterns, suggesting the influence of external factors beyond sentiment.

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## 4. Conclusion

This analysis highlights a counterintuitive but powerful insight: **fear, not greed, appears to drive the most intense trading activity and profitability.** While the limited overlap between datasets prevents broad generalization, the observed negative correlation between sentiment value and trading behavior indicates that market stress can create both liquidity and opportunity.

Future work with a longer continuous dataset would strengthen these findings and allow for deeper exploration of how sentiment regimes influence trading strategies.