# Data Science Assignment Report: Trader Behaviour vs Market Sentiment — Analysis

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**Executive Summary:**

This report analyses the relationship between **trader behaviour** (profitability, risk, trading volume, buy/sell bias, volatility) and **market sentiment** (Fear vs Greed).

The analysis merges the **Bitcoin Fear & Greed Index** with **Hyperliquid historical trading data**, aggregated into daily statistics. The purpose is to uncover how trading outcomes align with or diverge from sentiment regimes, and to identify **hidden patterns** that could serve as trading signals.

Key findings show that:

- Traders achieve the **highest profitability in Extreme Fear**, but with lower win-rates and high volatility.

- Traders record the **highest win-rates in Extreme Greed**, but with lower average profitability.

- **Fear-driven markets** trigger the largest trading volumes, while **Extreme Fear** leads to hesitation and low activity.

- **Risk-adjusted returns** are strongest in **Neutral** markets and weakest in **Greed**.

- **Lagged correlations** suggest greed predicts weaker future returns, while fear predicts stronger ones — supporting contrarian strategies.

**Methodology:**

1. **Data Preparation**

   o Cleaned sentiment data (date, value, classification).

   o Processed historical trading logs, converting numeric fields and standardizing side labels (BUY/SELL).

   o Aggregated trades into daily summaries:

     ▪ Average execution price

     ▪ Total USD and token volumes

     ▪ Average fees

     ▪ Total closed PnL

- Buy ratio (% of trades that were buys)

- Crossed ratio (order aggressiveness)

- PnL volatility

2. **Merging & Analysis**

   o Merged aggregated trading data with sentiment classifications.

   o Performed exploratory data analysis (EDA): distributions, boxplots, correlation heatmaps.

   o Analyzed profitability, win-rates, volume trends, and risk-adjusted returns by sentiment.

   o Conducted lagged correlation analysis to check predictive relationships.

**Key Findings:**

- **Profitability**

  o **Extreme Fear** → Highest profitability (average ≈ 10.9K PnL, median ≈ 18.6K).

  - Even with fewer winning days, profits are substantial when trades succeed.

  o **Greed** → Lowest profitability (average ≈ 3.6K).

  - Overconfidence and overtrading reduce returns.

- **Win-Rate**

  o **Extreme Greed** → Highest win-rate (≈ 88%).

  - Most trades succeed but yield smaller profits.

  o **Extreme Fear** → Lowest win-rate (≈ 64%).

  - Many losing trades, but the winners dominate in size.

- **Volume**

  o **Fear** → Highest trading activity (~$149M).

  - Suggests panic selling or repositioning.

  o **Extreme Fear** → Lowest activity (~$38M).

  - Traders hesitate, avoid risk, or stop trading.

- **Risk (Volatility)**

  o **Extreme Fear** → Highest volatility (~17.5K PnL std).

- Profits and losses are highly unstable.

  o **Greed** → Lowest volatility (~8.6K PnL std).

  - Lower variance but weaker returns.

- **Risk-Adjusted Returns**

  o **Neutral** → Best environment (Sharpe-like ratio ≈ 0.74).

  - Balanced emotions, consistent efficiency.

  o **Greed** → Weakest (≈ 0.43).

  - Overtrading reduces efficiency.

- **Lagged Correlation (Sentiment vs PnL)**

  o Correlations are consistently negative across lags.

  o Higher greed today predicts weaker returns over the next 1–7 days.

  o Higher fear today predicts stronger returns ahead.

  o Suggests sentiment is not only reflective but also predictive of outcomes.

**Summary Table: Key Metrics by Sentiment**

| Classification | Avg PnL | Median PnL | PnL Std | Win Rate | Avg Buy Ratio | Avg Crossed Ratio | Total Volume |
|---|---|---|---|---|---|---|---|
| Extreme Fear | 10,986 | 18,581 | 17,480 | 0.64 | 0.49 | 0.66 | 38,163,755 |
| Fear | 9,080 | 1,412 | 12,356 | 0.74 | 0.51 | 0.74 | 148,987,200 |
| Neutral | 8,769 | 1,819 | 11,861 | 0.67 | 0.50 | 0.78 | 90,918,800 |
| Greed | 3,645 | 678 | 8,571 | 0.73 | 0.49 | 0.79 | 133,488,700 |
| Extreme Greed | 7,625 | 3,128 | 10,482 | 0.88 | 0.46 | 0.66 | 108,309,700 |

**Insights & Interpretation:**

- **Extreme Fear** → High risk, high reward. Fewer wins but very profitable outcomes. Traders who act during fear benefit disproportionately.

- **Fear** → Heavy trading activity. Many traders react to fear by selling or repositioning.

- **Neutral** → Most balanced and efficient environment. Profits are steady, volatility is moderate, and traders behave rationally.

- **Greed** → Worst efficiency. Traders overtrade and chase rallies, leading to poor risk-adjusted returns.

- **Extreme Greed** → Safer, higher win-rate but smaller average profits.

**Actionable Insights:**

1. **Contrarian Strategy**

   o Buy opportunities in **Extreme Fear** → Markets overreact, disciplined traders can capture outsized gains.

   o Reduce exposure in **Extreme Greed** → Many wins occur, but profitability is inefficient; bubbles are possible.

2. **Neutral Sentiment Trading**

   o Best time for systematic strategies (algos, trend-following) — consistent and efficient environment.

3. **Risk Management**

   o Volatility is highest in **Extreme Fear**. Use smaller position sizes and tighter stops.

   o Greed-driven markets require monitoring for over-leverage and inefficiency.

**Conclusion**

This analysis confirms that trader behaviour is closely tied to sentiment, but outcomes differ significantly across regimes.

- **Extreme Fear** → High average profits, high volatility, and fewer wins → "High Risk, High Reward."

- **Extreme Greed** → Safer environment with many small wins but lower profitability.

- **Neutral** → Most efficient, balanced environment for consistent profits.

- **Greed overall** → Risk of overtrading and poor efficiency.

The **Fear & Greed Index** can be used as a **contrarian signal**:

- **Fear = Opportunity**

- **Greed = Caution**

This insight can guide smarter trading strategies in Web3 markets, helping traders optimize risk and reward.