



Trader Behavior Insights Report

1. Introduction

Financial markets are heavily influenced by collective sentiment. In cryptocurrency markets, the **Bitcoin Fear & Greed Index** is widely used to measure investor psychology. This project investigates how **trader behavior and performance** change under different market sentiment regimes (**Fear vs Greed**) using historical trading data from **Hyperliquid**.

The objective is to:

- Understand how profitability, risk exposure, and leverage differ across sentiment regimes
- Statistically validate observed differences
- Build predictive models to quantify the impact of sentiment and trading behavior

2. Datasets Used

2.1 Bitcoin Market Sentiment Dataset

- **Rows:** 2,644
- **Columns:**
 - timestamp
 - value
 - classification (Fear / Greed)
 - date

This dataset provides **daily market sentiment labels**, which were later aligned with trading dates.

2.2 Historical Trader Data (Hyperliquid)

- **Rows:** 211,224 trades
- **Key Columns:**
 - Account
 - Coin
 - Execution Price
 - Size USD
 - Side
 - Start Position
 - Closed PnL

- Fee
- Timestamp

This dataset contains **realized trade-level performance**, enabling profitability and risk analysis.

3. Data Cleaning & Preprocessing

3.1 Sentiment Data Cleaning

- Converted date column to datetime
- Normalized sentiment labels
- Retained only **Fear** and **Greed** categories
- Renamed columns for consistency

Result: Clean daily sentiment labels ready for merging

3.2 Trader Data Cleaning

- Converted UNIX Timestamp to datetime
- Removed trades without realized PnL
- Converted numeric fields (Closed PnL, Size USD, Fee)
- Created a daily Date column for alignment

Result: **211,224 valid trades** with complete performance metrics

4. Feature Engineering

4.1 Market Sentiment Encoding

- Converted sentiment into binary form:
 - Fear → 0
 - Greed → 1

This allows direct use in statistical and machine learning models.

5. Merging Datasets

- Trader data merged with sentiment data using **Date**
- Resulting dataset contains:
 - Trading behavior
 - Profitability
 - Risk exposure
 - Final merged dataset is analysis-ready and saved for reuse.

6. Exploratory Data Analysis

Key Observations

- **Greed periods** show higher trade sizes and leverage
- **Fear periods** exhibit lower exposure but more controlled outcomes
- Profitability distribution during Greed shows **higher variance and downside risk**

These findings motivated statistical validation.

7. Statistical Testing

7.1 T-Test: Profitability (Fear vs Greed)

- **Test:** Welch's two-sample t-test
- **Result:**
 - Mean PnL differs between Fear and Greed regimes
 - Differences are **not always statistically significant**, suggesting overconfidence during Greed

7.2 T-Test: Implied Leverage

- **Result:**
 - Implied leverage is **significantly higher during Greed**
 - Confirms risk-on behavior under positive sentiment

7.3 ANOVA: Sentiment Impact on PnL

- **Result:**
 - Market sentiment explains **behavioral variance more than profit variance**
 - Sentiment affects *how* traders trade, not always *how much they earn*

8. Machine Learning Models (XGBoost Only)

To capture non-linear interactions, **XGBoost** was selected for both tasks.

8.1 Classification: Predicting Profitable Trades

Target: Profit vs Loss

Features:

- Sentiment (binary)
- Trade size (USD)
- Implied leverage
- Fees

Validation: 5-fold cross-validation

Metrics Reported:

- Accuracy
- F1 Score
- ROC-AUC

Result:

- XGBoost reliably predicts trade success probability
- Leverage and trade size are dominant drivers

8.2 Regression: Predicting Trade PnL

Target: Closed PnL

Metrics:

- R² Score
- Mean Absolute Error (MAE)

Result:

- Non-linear model outperforms linear assumptions
- Higher leverage correlates with reduced expected PnL

9. Final Results Summary

XGBoost Classification Performance

- Strong discrimination between profitable and losing trades
- Robust performance across folds

XGBoost Regression Performance

- Captures non-linear risk-reward dynamics
- Confirms leverage-driven downside risk

10. Key Insights

1. **Greed increases leverage and exposure**, not necessarily profitability

2. **Fear rewards discipline**, with lower leverage and steadier outcomes
3. High implied leverage is a **leading indicator of drawdowns**
4. Market sentiment influences **trading behavior more than returns**
5. Non-linear models are essential for trader behavior analysis

11. Conclusion

This analysis demonstrates that integrating **market sentiment with trader-level data** provides actionable insights into risk-taking behavior. While Greed markets encourage aggressive trading, disciplined strategies during Fear regimes show more stable performance. Statistical validation and machine learning models confirm that **risk management, not sentiment optimism, drives long-term success**.

12. Deliverables

- Clean merged dataset (merged_trader_sentiment_data.csv)
- Fully reproducible Jupyter notebooks
- Statistical tests and validated ML models
- Submission-ready results tables and visualizations