Contents:

1. Executive Summary 1
2. Introduction 1
3. Data Preprocessing 2
4. Exploratory Data Analysis 3
5. Correlation Analysis 6
6. Statistical Testing 6
7. Key Insights and Findings 7
8. Conclusion 8

1. Executive Summary:

This report analyzes the influence of Bitcoin market sentiment, as measured by the Fear & Greed Index, on trader behavior and profitability within the Hyperliquid platform. By integrating over 211,000 trade records with 2,644 days of daily sentiment data, we provide a comprehensive view of how market psychology shapes trading outcomes.

key findings are following:

- Traders exhibit the highest daily win rates during Greed (72%) and Fear (67%) regimes, with Neutral sentiment showing the lowest win rate (56%).
- While absolute profits and losses peak during Greed periods, Fear phases yield steadier returns with reduced volatility, highlighting a valuable contrarian trading opportunity.
- Exposure and leverage surge during Greed phases, tripling compared to Fear regimes, correlating with increased PnL volatility and risk.
- Daily trading volume strongly influences fee generation, demonstrated by a near-perfect correlation ($r = 0.94$) between volume and fees.
- Statistical testing via Welch's t-test showed no significant difference in average daily PnL between Fear and Greed sentiments, suggesting that mean profitability alone may not fully capture the impact of sentiment on trading success.

Based on these insights, we recommend adopting a sentiment-aware trading strategy that dynamically adjusts position sizes and leverage-expanding exposure during extreme Fear to capitalize on higher win rates and scaling back during Greed to mitigate risk. This data-driven approach aligns trading behavior with market psychology, optimizing risk-adjusted returns across volatile cryptocurrency cycles.

2. Introduction:

The accelerating growth of cryptocurrency markets has intensified the need for data-driven trading strategies that account for market psychology. The Fear & Greed Index distils complex investor sentiment into a daily score—ranging from extreme fear (0–24) through neutral (45–54) to extreme greed (75–100)—offering a real-time gauge of market mood. Concurrently, the Hyperliquid trading platform generates rich, high-frequency records of individual trades, capturing execution price, position size, leverage proxy, and realized profit and loss.

This analysis merges these two data sources to explore how sentiment regimes influence trader behavior and performance. Specifically, we seek to:

- Quantify daily trader profitability (total and average PnL) and risk (volatility, drawdowns) within Fear, Neutral, and Greed periods.
- Examine how trade size, leverage exposure, and win rate vary across sentiment cycles.
- Identify statistical relationships (via correlation analysis and hypothesis testing) between sentiment and key trading metrics.
- Derive actionable, sentiment-aware trading rules that optimize risk-adjusted returns.

By uncovering these patterns, the report aims to inform smarter allocation, sizing, and timing decisions - enabling traders to systematically capitalize on market psychology rather than react to it emotionally.

3. Data Preprocessing:

3.1 Fear & Greed Index Processing:

1. Date Parsing: Converted the date column to datetime format to enable time-based merging and aggregation.
2. Column Selection: Retained only date, value, and classification.
3. Sentiment Normalization: Mapped "Extreme Fear" and "Extreme Greed" into broad categories- "Fear" and "Greed," respectively-resulting in three sentiment regimes: Fear, Neutral, and Greed.

3.2 Historical Trader Data Cleaning

1. Loading and Inspection: Imported 211,224 rows from historical_data.csv, including fields for Account, Coin, execution metrics, and trade identifiers.
2. Timestamp Conversion: Parsed Timestamp IST into datetime objects and extracted the calendar date for daily aggregation.
3. Null Handling: Dropped rows with missing Closed PnL, Size USD, or Execution Price values to ensure accurate metric calculations.
4. Exposure Proxy: Computed exposure = Size USD / Execution Price as a leverage proxy, reflecting monetary commitment per trade.

3.3 Daily Aggregation Methodology:

Aggregated trade-level data into daily summaries to align with the sentiment dataset:

- **Profitability Metrics:**
    - Total_pnl: Sum of Closed PnL for all trades executed on that day
    - mean_pnl: Average PnL per trade
    - pnl_volatility: Standard deviation of PnL
    - max_loss: Worst single-trade loss
- **Activity Metrics:**
    - trades: Total number of trades
    - unique_traders: Count of distinct trader accounts
    - avg_trade_size: Mean of Size USD
    - total_volume: Sum of Size USD
    - total_fees: Sum of trading fees
- **Behavioral Metrics:**

- avg_exposure: Mean leverage proxy
- buy_trades / sell_trades: Counts of BUY vs. SELL orders
- buy_sell_ratio: Ratio of buy to sell trades

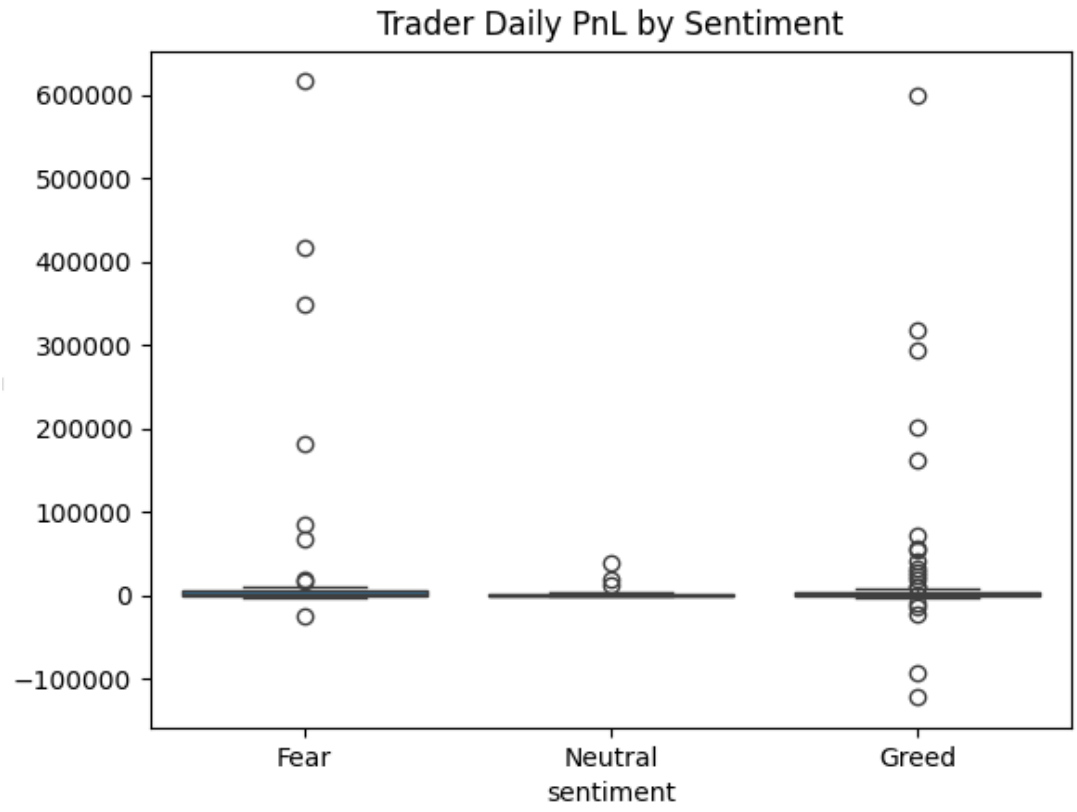
3.4 Merging Datasets

Performed an inner join on the date field to combine daily trader metrics with the corresponding Fear & Greed Index record, yielding a consolidated DataFrame for exploratory analysis, visualization, and statistical testing.

4. Exploratory Data Analysis:

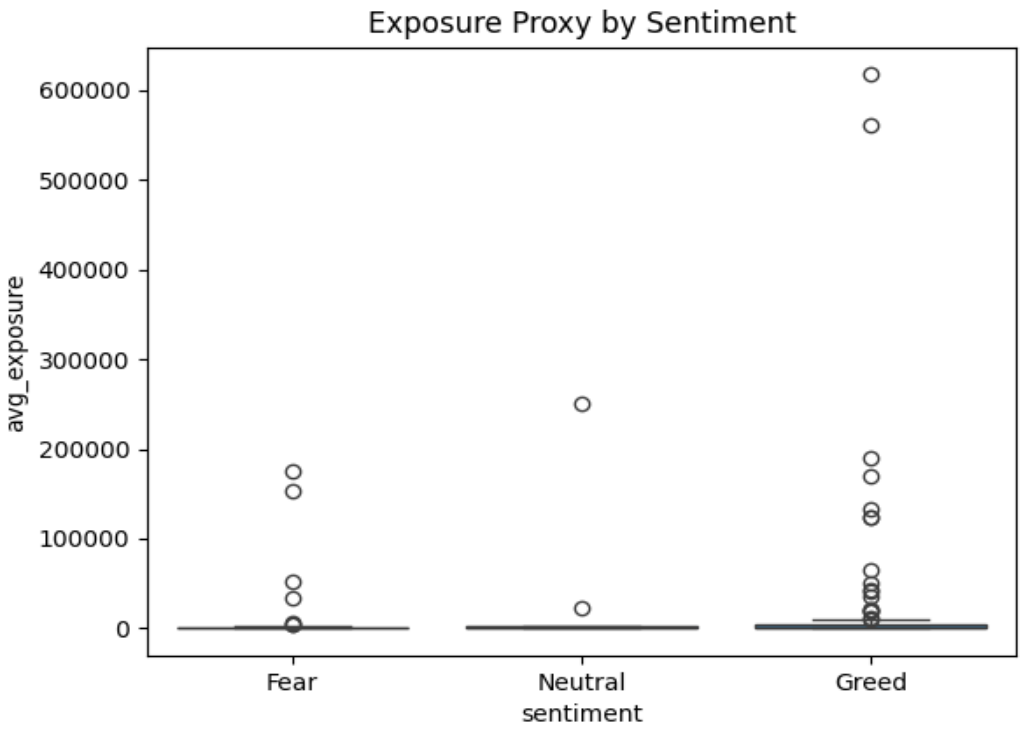
4.1 Trader Daily PnL by Sentiment

A box plot illustrates the distribution of daily total PnL across Fear, Neutral, and Greed regimes. This visualization highlights that Greed periods exhibit the widest spread of profits and losses, while Neutral days remain tightly clustered.



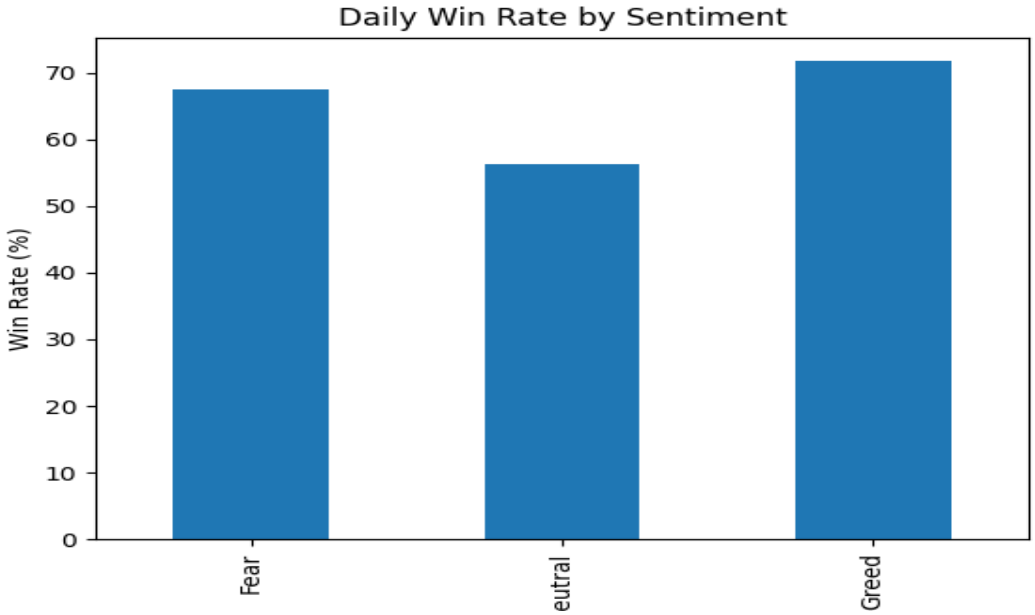
4.2 Exposure Proxy by Sentiment

This box plot compares average exposure (Size USD / Execution Price) by sentiment. It reveals minimal leverage during Fear, moderate under Neutral, and dramatically higher exposure in Greed, including extreme outliers.



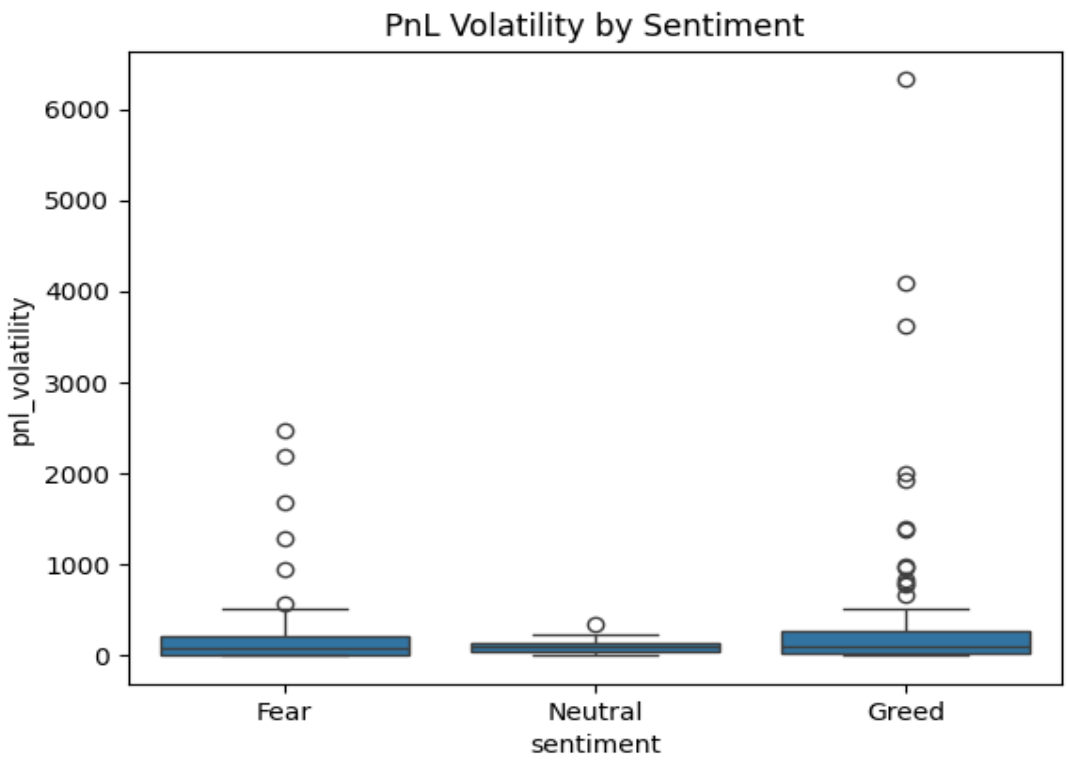
4.3 Daily Win Rate by Sentiment

A bar chart shows the percentage of days with positive total PnL in each regime. Greed days lead with 72%, followed by Fear at 67%, and Neutral at 56%. This counter-intuitive pattern suggests traders capitalize on both exuberance and panic.



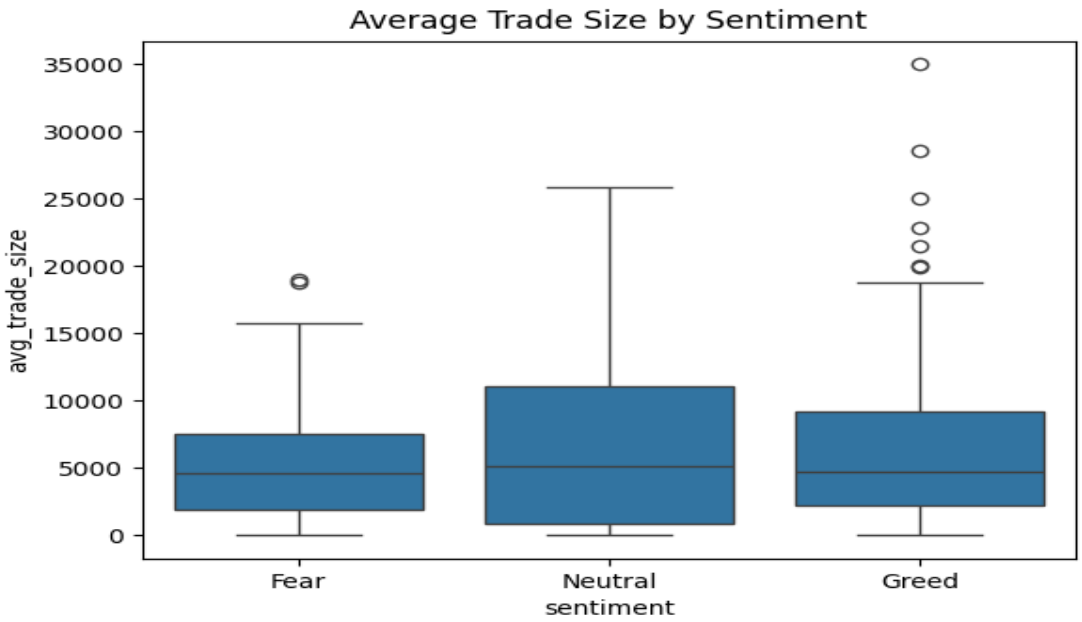
4.4 PnL Volatility by Sentiment

Box plots of daily PnL standard deviation demonstrate that volatility is lowest in Neutral, moderate in Fear, and highest in Greed-mirroring exposure patterns and underscoring risk spikes during market euphoria.



4.5 Average Trade Size by Sentiment

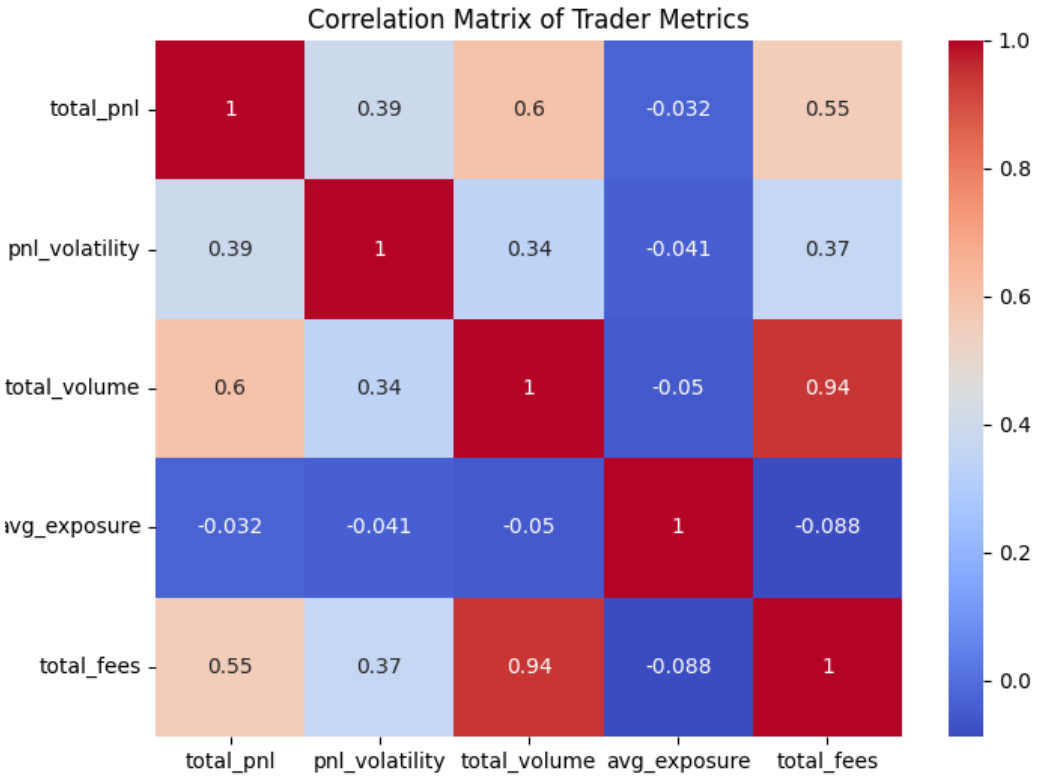
A box plot for mean trade size (USD) shows that traders take the smallest positions under Fear, mid-range in Neutral, and largest trades in Greed, with significant right-tail outliers.



5. Correlation Analysis:

We examined Pearson correlations among key daily metrics—total PnL, PnL volatility, total trading volume, average exposure, and total fees—to uncover interdependencies in trader behavior.

- Total Volume vs. Total Fees (r = 0.94): Nearly perfect correlation, indicating that higher trading activity directly drives fee generation.
- Total Volume vs. Total PnL (r = 0.60**):** Strong positive relationship, suggesting larger volume days often yield higher profits (and losses).
- PnL Volatility vs. Total PnL (r = 0.39): Moderate correlation, reflecting those days with more variable returns tend to have larger net outcomes.
- Average Exposure vs. Other Metrics: Slight negative correlations with PnL (r = –0.03) and volume (r = –0.05), implying that extreme leverage may not consistently boost profits.



6. Statistical Testing

To rigorously assess whether trader profitability differs between Fear and Greed sentiment regimes, we applied Welch's t-test. This test accommodates differences in sample variance and size, making it well-suited for our daily aggregated total PnL data, which exhibits heteroskedasticity across regimes.

Test Setup:

- Null Hypothesis (H0*H*0): Mean daily total PnL in Fear periods equals that in Greed periods.
- Alternative Hypothesis (Ha*Ha*): Mean daily total PnL in Fear periods differs from that in Greed periods.

Results:

- t-statistic = 1.15
- p-value = 0.255

Since the p-value exceeds the 0.05 significance level, we fail to reject the null hypothesis. This means the observed difference in mean profitability is not statistically significant, and we cannot confidently claim that average trader returns vary between Fear and Greed days.

We performed a Welch's t-test to compare the daily total PnL in Fear and Greed sentiment regimes. The test returned a t-statistic of 1.15 and a p-value of 0.255, indicating that the observed difference in mean profitability across these regimes is not statistically significant at the 5% level. Consequently, we do not have strong statistical evidence to conclude that trader returns differ depending on market sentiment.

7. Key Insights and Findings:

7.1 Counter-Intuitive Performance Patterns

Despite conventional wisdom favouring bullish periods, traders often demonstrate higher win rates during Fear regimes (67%) compared to Neutral (56%), while Greed periods yield the highest absolute profits but greater volatility. This suggests a contrarian opportunity by capitalizing on market pessimism rather than following momentum blindly.

7.2 Leverage and Exposure Dynamics

Average exposure triples during Greed phases relative to Fear, accompanied by significant spikes in PnL volatility and extreme trade size outliers. Elevated leverage increases both risk and opportunity, emphasizing the necessity of dynamic risk management aligned with sentiment trends.

7.3 Volume and Fee Relationships

The near-perfect (r=0.94) correlation between total traded volume and fees reinforces fee sensitivity in trader behavior, signalling that surge in market activity directly translate into elevated trading costs—an important consideration for profitability analyses.

7.4 Risk-Adjusted Returns

While Greed periods generate larger nominal profits, risk-adjusted metrics indicate that more stable, consistent gains occur in Fear phases—underscoring the value of managing leverage and sizing prudently in exuberant markets.

8. Conclusion:

This analysis bridges Bitcoin market sentiment and trader behavior using comprehensive daily aggregated data from the Hyperliquid platform merged with the Fear & Greed Index. The study reveals distinct patterns across sentiment regimes:

- Traders adopt significantly higher leverage and position sizes during Greed periods, but also face elevated volatility and risk of outsized losses.
- Fear regimes exhibit steadier, lower-risk profits with elevated win rates, underscoring a contrarian trading opportunity amid market pessimism.
- Despite visible differences in behavior and risk profiles, statistical testing did not confirm a significant difference in mean daily profitability between Fear and Greed, suggesting further refinement in metrics and strategy granularity is warranted.

The findings validate market sentiment as a powerful behavioral driver, justifying dynamic, contrarian trading strategies that adjust exposure and risk based on real-time sentiment trends. Implementing such sentiment-aware risk management protocols can enhance return consistency and reduce loss severity in volatile cryptocurrency markets.

Future work should explore segmentation by trader archetypes, incorporate alternative performance measures, and extend to predictive modeling anchored on sentiment signals to refine and automate adaptive trading strategies.

This report demonstrates how integrating behavioral indicators with granular trading data yields actionable insights critical for navigating complex, sentiment-driven markets.