DATA SCIENCE ASSIGNMENT

ANALYSIS OF TRADER BEHAVIOR VS MARKET SENTIMENT (FEAR, GREED)

SUBMITTED BY

NAME : P N YOGESWARAN

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1. Introduction

Financial markets are highly influenced by human emotions such as fear and greed. These emotions often affect how traders take risks, place trades, and manage their positions. Understanding how trader behavior changes under different market sentiments can help in building smarter and more disciplined trading strategies.

The objective of this project is to analyze how trading behavior — specifically profitability, risk, trading volume, fees, and timing behavior — aligns or diverges from overall market sentiment (Fear vs Greed). Based on this analysis, the project also aims to identify hidden patterns and data-backed trading signals that can guide better decision-making.

2. Datasets Used

Two datasets were used in this analysis:

2.1 Bitcoin Market Sentiment Dataset

This dataset represents the daily market sentiment derived from the Fear & Greed Index.

Key columns:

- date – Calendar date
- classification – Market sentiment (Fear, Extreme Fear, Greed, Extreme Greed)
- value – Sentiment index score

This dataset provides daily sentiment context for the market.

2.2 Historical Trader Data (Hyperliquid)

This dataset contains detailed trade-level information from traders.

Key columns used:

- Account – Trader identifier
- Coin – Traded asset
- Execution Price – Price at which trade was executed
- Size USD – Trade size in USD (used as risk proxy)
- Side – BUY or SELL
- Timestamp IST – Trade execution time
- Closed PnL – Profit or loss from trade
- Fee – Trading fee paid per trade

This dataset provides actual trading behavior at an individual trade level.

3. Data Preparation and Cleaning

3.1 Date and Time Handling

- The trader timestamp column (Timestamp IST) was originally stored as plain text.
- It was converted into a proper datetime format to allow time-based analysis.
- A separate date-only column was extracted from the timestamp to align with the daily sentiment dataset.

This ensured that:

- Intraday behavior could still be analyzed
- Daily sentiment data could be merged correctly

3.2 Sentiment Simplification

The sentiment dataset contained four categories:

- Fear
- Extreme Fear
- Greed
- Extreme Greed

For clearer analysis, these were grouped into two categories:

- Fear → Fear + Extreme Fear
- Greed → Greed + Extreme Greed

This binary classification helps in comparing trader behavior more effectively.

3.3 Dataset Merging

- Both datasets were merged using the date column
- An inner join was used to keep only matching dates
- The final merged dataset contains both trade details and sentiment labels

This merged dataset became the foundation for all further analysis.

4. Feature Engineering

To support deeper analysis, additional features were derived:

- Sentiment Group – Fear or Greed
- Hour of Trade – Extracted from timestamp for intraday analysis
- Loss Indicator – Trades with negative Closed PnL
- Risk Proxy – Trade size in USD used as a measure of risk exposure

These features helped in analyzing behavior from multiple perspectives.

5. Exploratory Data Analysis (EDA)

5.1 Profitability Analysis

Profitability was analyzed by comparing:

- Average Closed PnL
- Median Closed PnL
- Percentage of profitable trades
- Average loss size

Observation:

- Greed periods showed higher average profits
- However, Greed also showed larger losses and more volatility
- Fear periods showed more controlled and stable outcomes

5.2 Trading Volume Analysis

Trading volume was measured using:

- Average trade size (USD)
- Total traded volume
- Number of trades

Observation:

- Trading activity was significantly higher during Greed
- Traders placed more and larger trades during Greed
- Fear periods showed reduced participation

5.3 Risk Behavior Analysis

Risk exposure was analyzed using trade size as a proxy.

Observation:

- Average and maximum trade sizes were higher during Greed
- Position size variability was also higher during Greed
- This indicates aggressive and emotional risk-taking behavior

5.4 Fee Analysis (Hidden Cost)

Fees were analyzed to understand hidden trading costs.

Observation:

- Total fees paid were much higher during Greed
- Increased trading frequency leads to higher transaction costs
- High gross profits during Greed may be reduced by fees

5.5 Loss-Focused Analysis

Loss behavior was studied by analyzing:

- Average loss size
- Worst loss
- Frequency of large losses

Observation:

- Extreme losses occurred more frequently during Greed
- Fear periods showed fewer catastrophic drawdowns
- This highlights the danger of overconfidence during optimistic markets

5.6 Directional Bias Analysis

BUY vs SELL behavior was compared across sentiments.

Observation:

- Strong BUY bias during Greed
- More balanced behavior during Fear
- BUY trades during Greed showed weaker risk-adjusted performance

5.7 Time-Based (Intraday) Analysis

Trades were analyzed by hour of the day.

Observation:

- Greed-driven trades clustered around specific hours
- High activity during these hours did not always lead to better profitability
- Indicates crowding and herd behavior

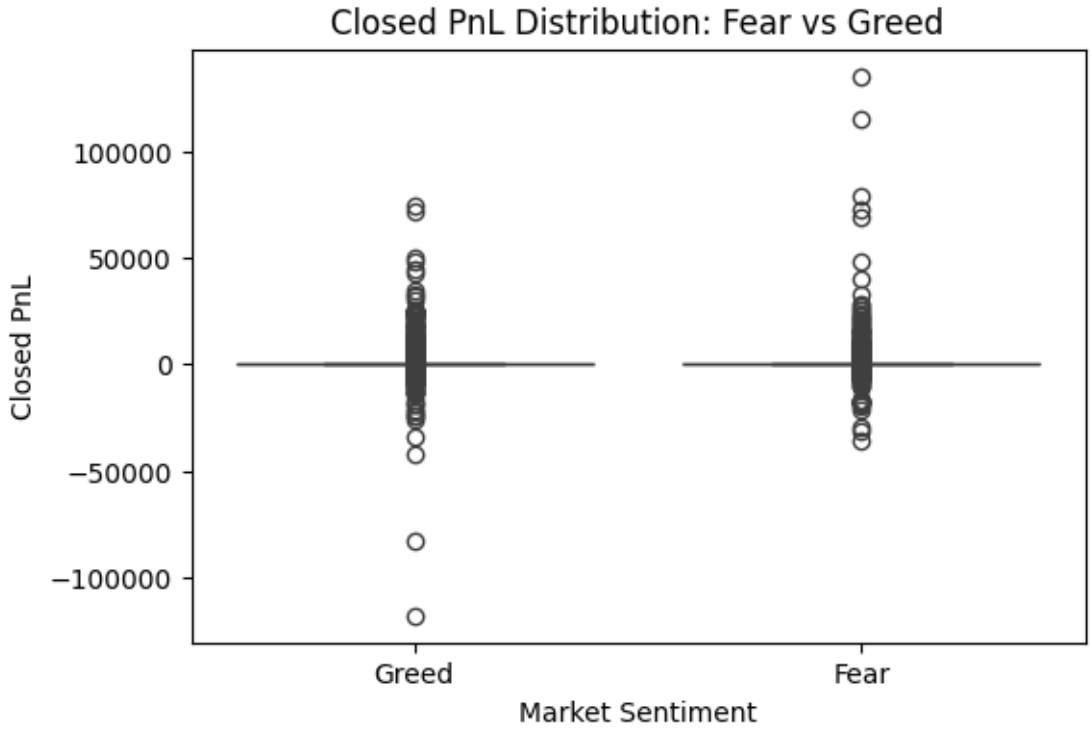
6. Visualizations

To support the findings, the following visualizations were created and saved They are :

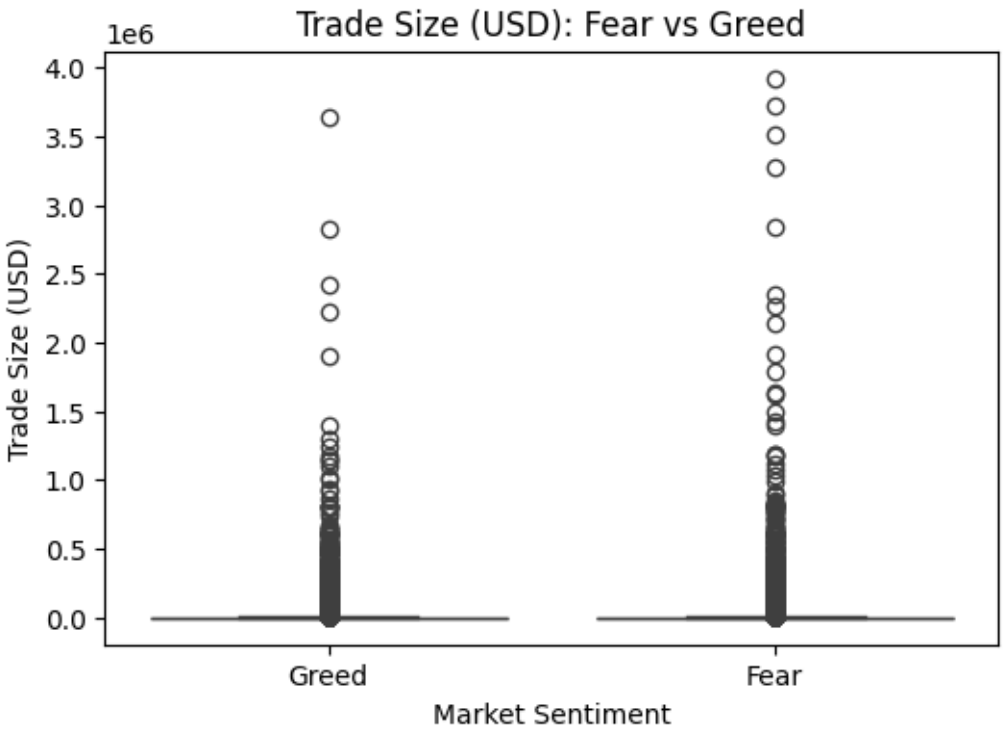
- Closed PnL vs Market Sentiment
- Trade Size vs Market Sentiment
- Fee vs Market Sentiment
- Trade Count vs Market Sentiment
- Loss Distribution vs Market Sentiment
- Trades per Hour vs Market Sentiment
- Average PnL per Hour vs Market Sentiment

These visualizations provided clear evidence for all behavioral observations.

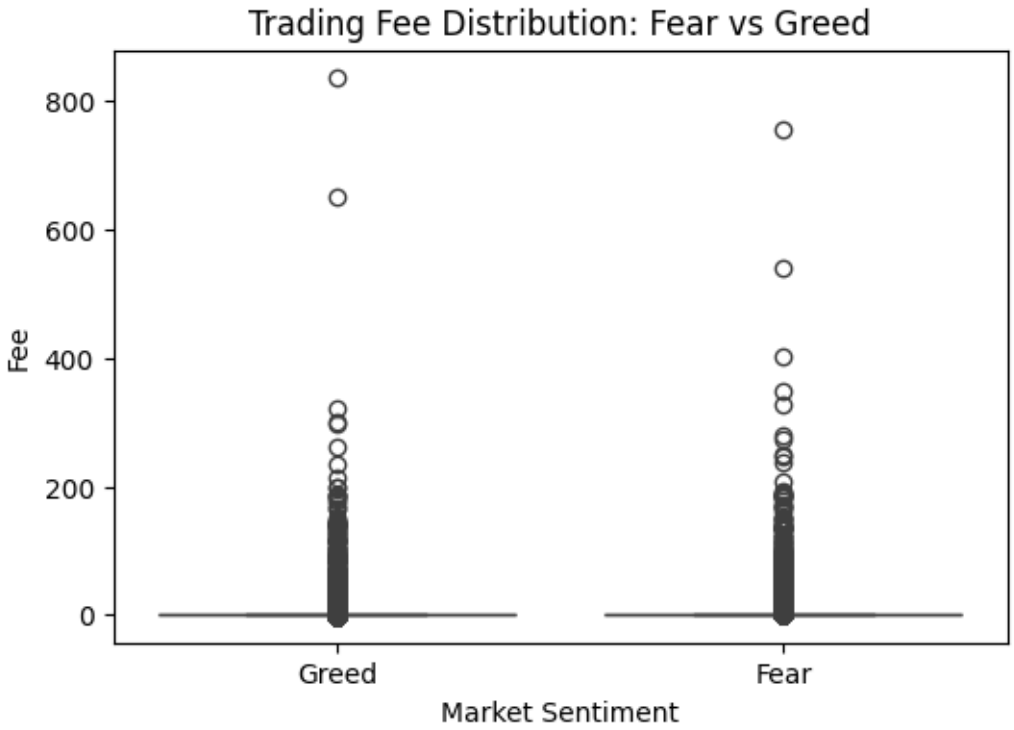
Closed Pnl VS Market Sentiment :



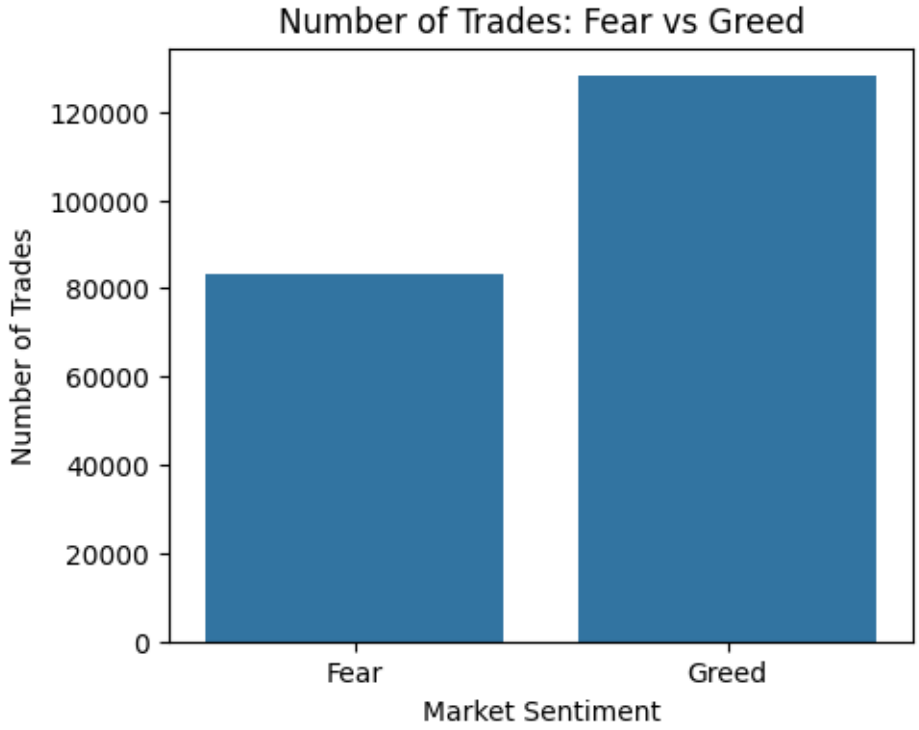
Trade Size VS Market Sentiment:



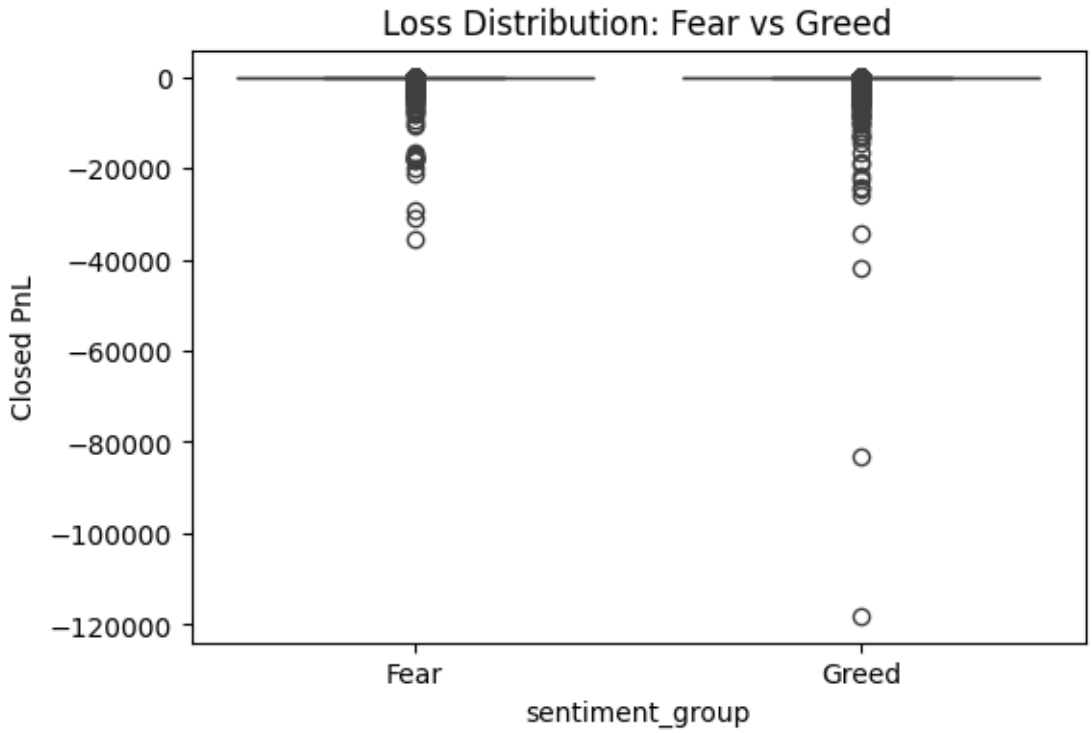
Fee VS Market Sentiment :



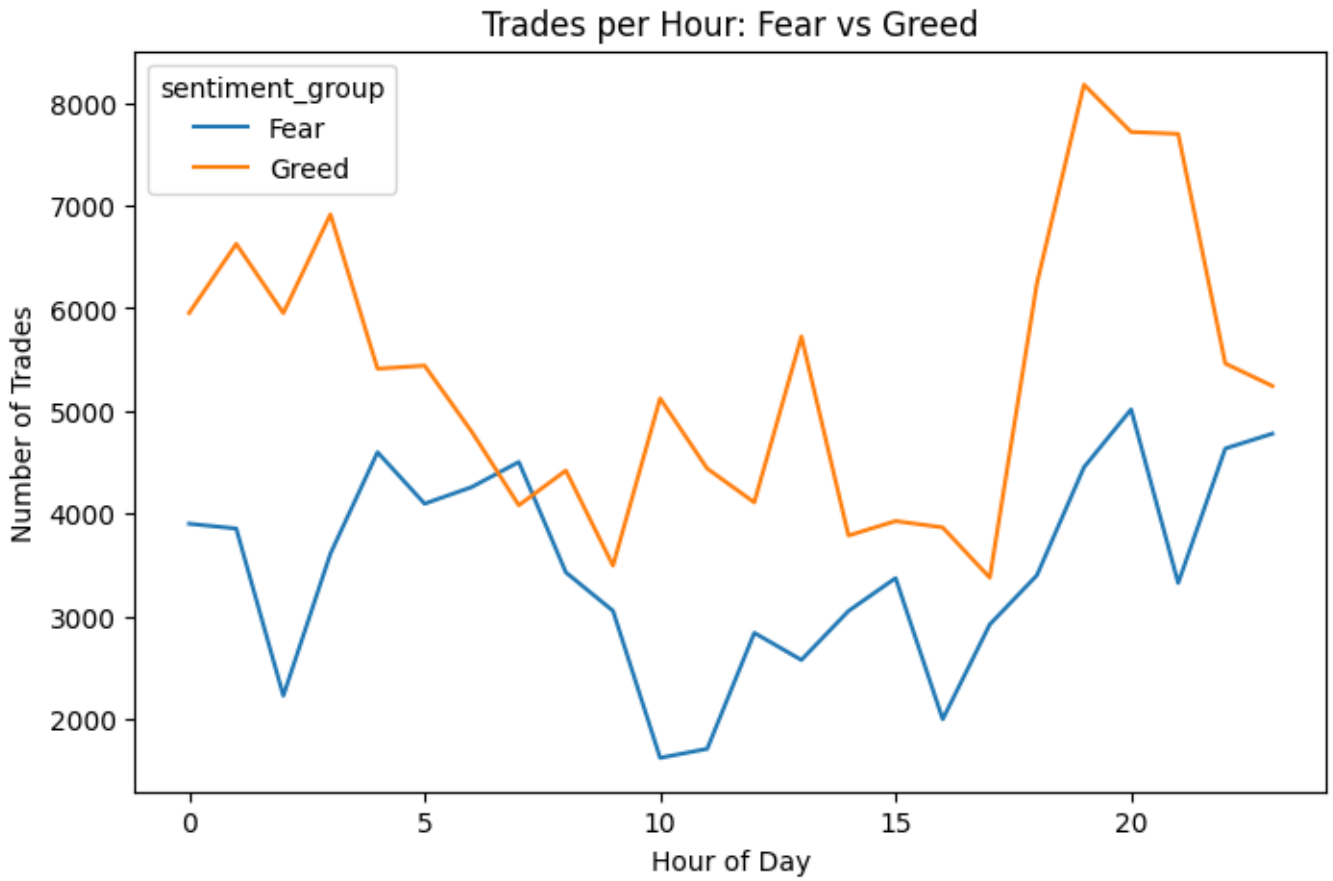
Trade Count VS Market Sentiment :



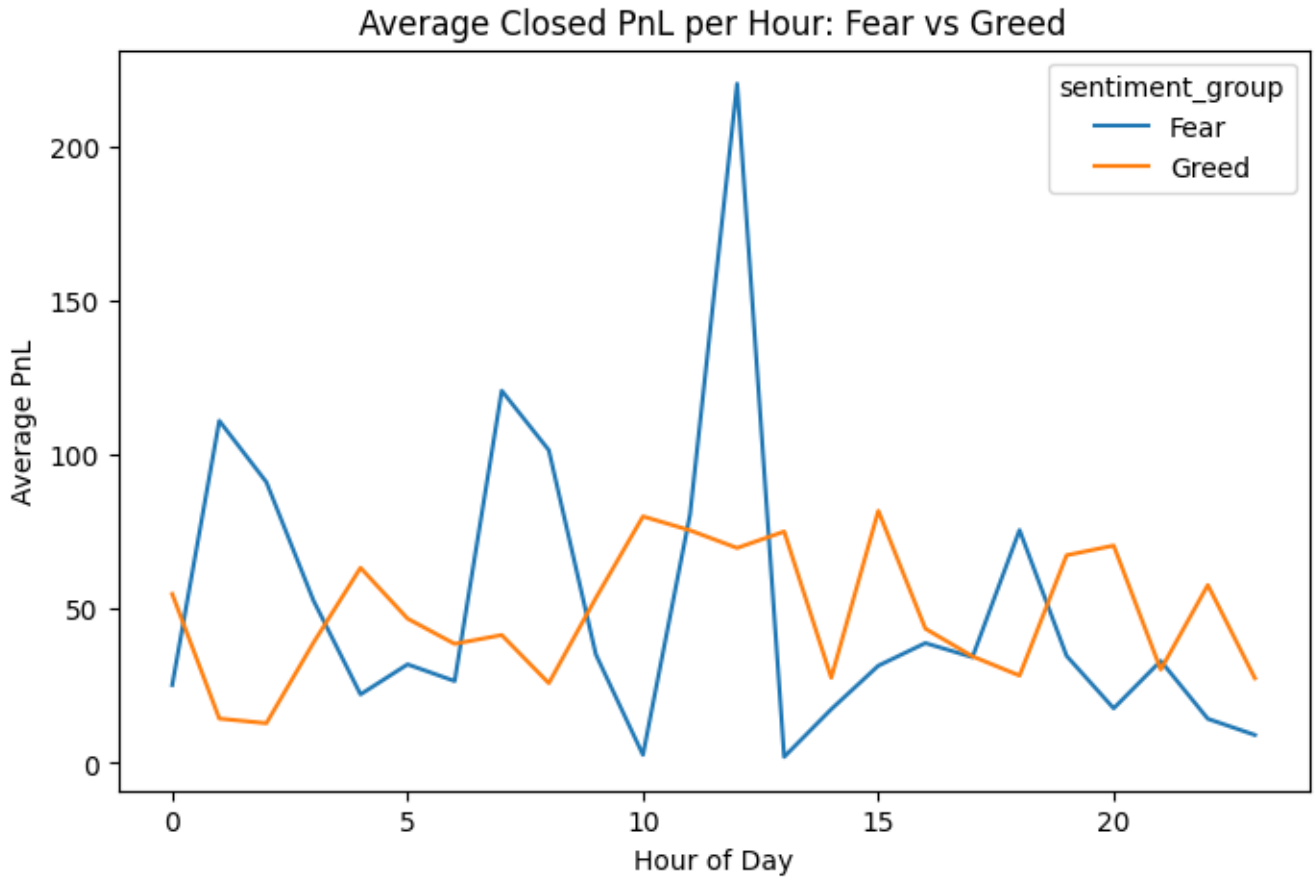
Loss Distribution VS Sentiment :



Trades Per Hour VS Market Sentiment:



Average Pnl VS Market Sentiment:



7. Key Trading Signals Identified

Based on data-driven analysis, the following trading signals were identified:

1. Reduce position size during Greed to avoid excessive risk
2. Control trade frequency during Greed to minimize fees
3. Avoid emotional overtrading during Extreme Greed
4. Fear periods offer better risk-adjusted returns
5. Intraday crowding signals potential reversal risk

These signals can help traders design sentiment-aware strategies.

8. Conclusion

This project demonstrates that trader behavior is strongly influenced by market sentiment. While Greed periods encourage higher profits, they also introduce higher risk, volatility, and hidden costs. Fear periods, although less profitable, provide better risk control and stability.

By adapting trading strategies based on market sentiment — especially position sizing, trade frequency, and timing — traders can improve long-term performance and reduce emotional decision-making.

9. Limitations and Future Scope

Limitations:

- Analysis is limited to available historical data
- Leverage information was approximated using trade size
- Only Bitcoin-related sentiment was considered

Future Improvements:

- Include multiple assets
- Use actual leverage data
- Apply predictive modeling for sentiment-based strategies