REPORT

1. Project Title: **Exploring and Analyzing the relationship between trader behavior and market sentiment using two key datasets**

2. Introduction

This project explores the relationship between **cryptocurrency market sentiment (Fear / Greed)** and **trader behavior**, using:

- The **Bitcoin Fear & Greed Index**
- **Historical Trader Data from Hyperliquid**

The objective is to understand how sentiment affects:

- Profitability
- Trading volume
- Trade direction (Long/Short)
- Exposure (Start Position)
- Overall trading activity

This analysis aims to identify patterns that can inform **better trading strategies and risk decisions**.

3. Dataset Description

This project uses two datasets:

3.1 Fear & Greed Index Dataset

This dataset provides daily Bitcoin market sentiment using the Fear and Greed Index.
Each row represents the sentiment level on a specific date.

Columns:

- **timestamp:**
  Unix timestamp (in seconds) showing when the index was recorded.

- **value:**
  Numerical Fear & Greed score (0–100), where:
    - 0–24 → Extreme Fear
    - 25–44 → Fear
    - 45–54 → Neutral
    - 55–74 → Greed
    - 75–100 → Extreme Greed
- **classification:**
  Categorical sentiment label (e.g., *Fear*, *Greed*, *Neutral*, *Extreme Greed*).
- **date:**
  Human-readable date (YYYY-MM-DD) converted from the Unix timestamp.
  Used as the primary key to merge with the trader dataset.

3.2 Hyperliquid Trader Dataset

This dataset contains trade-by-trade execution records from Hyperliquid.
Each row represents a single trading action (buy, sell, open long, close short, etc.).

Columns:

- **Account:**
  Wallet address or exchange account used for placing trades.
- **Coin:**
  Trading pair or coin symbol (e.g., BTC, ETH).
- **Execution Price:**
  Price at which the trade was executed.
- **Size Tokens:**
  Number of tokens bought or sold in the trade.

- **Size USD:**
  Total trade value in USD.

- **Side:**
  Order type — BUY or SELL.

- **Timestamp IST:**
  Exact time of the trade in Indian Standard Time.

- **Start Position:**
  Position size before executing the trade.

- **Position:**
  Updated position size after the trade.

- **Direction:**
  Trade direction category (e.g., Buy, Sell, Open Long, Close Short, etc.).

- **Closed:**
  Boolean value showing whether the trade closed a position.

- **PnL:**
  Realized Profit or Loss from the trade.

- **Transaction Hash:**
  Blockchain transaction ID for on-chain verification.

- **Order ID:**
  Exchange-generated ID for the trade order.

- **Crossed:**
  Indicates whether the order crossed the order book (market order).

- **Fee:**
  Fee charged for this trade.

- **Trade ID:**
  Unique identifier for the execution event.

- **Timestamp:**
  Unix timestamp of the trade (in scientific notation).
  Converted to readable datetime (Timestamp) and `date` for merging.

4. Data Cleaning Steps

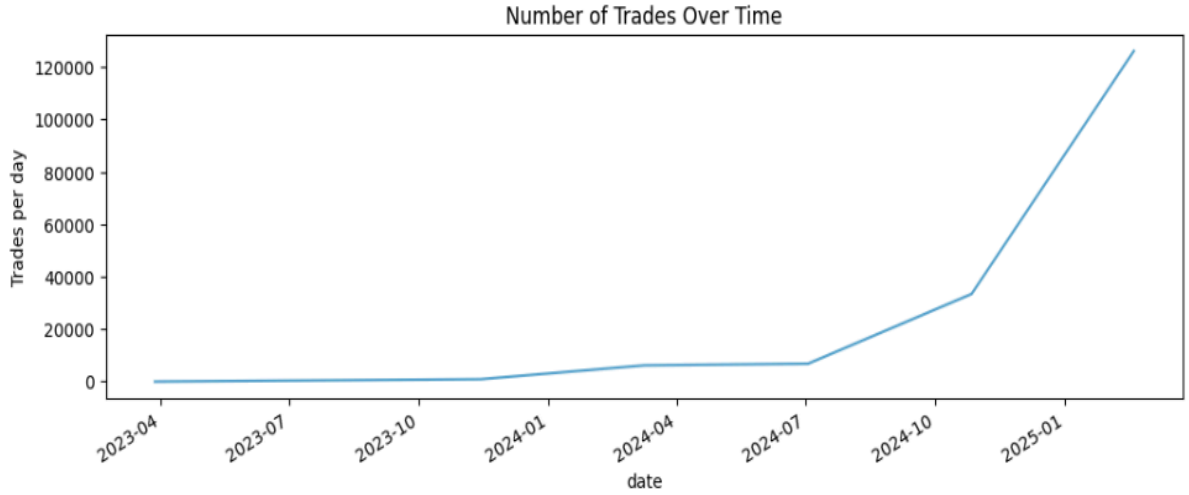
- Converted timestamp (ms → datetime)
- Extracted daily date for merging
- Dropped unnecessary columns:
  timestamp, value, Transaction Hash, Order ID, Trade ID, Timestamp IST
- Checked for missing values
- Converted categorical fields to consistent labels
- Merged datasets using: df_merged = pd.merge(df2, df1[['date','classification']], on='date', how='left')
- Ensured final dataset contains **only relevant features**

5. Exploratory Data Analysis (EDA)

5.1 Daily Trading Activity

Graph: Number of Trades Over Time (Line Chart)

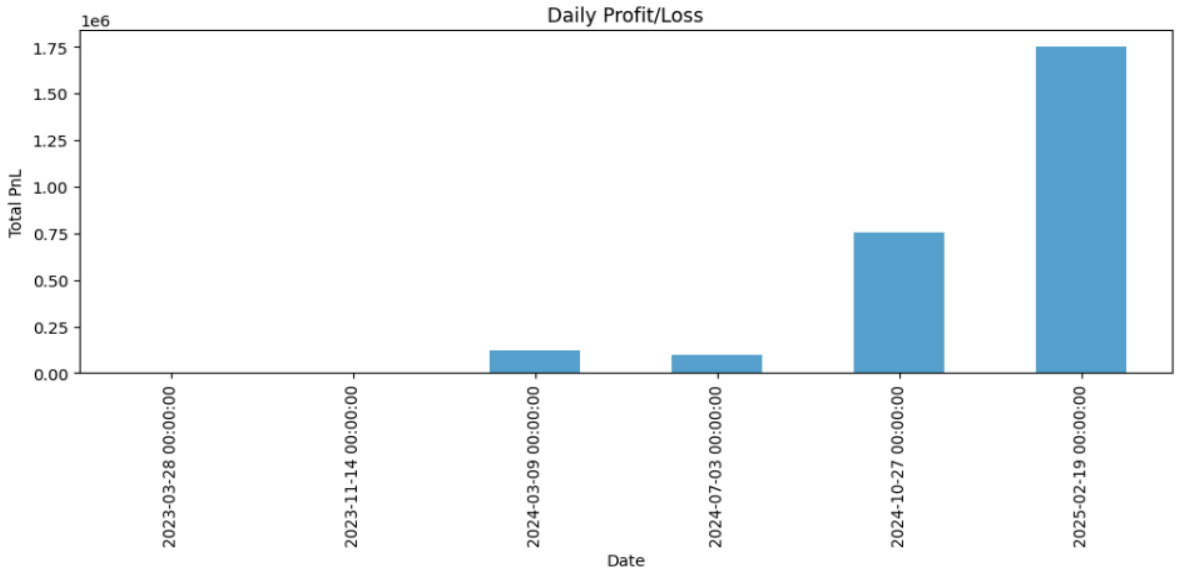
Insight:
Trading activity steadily increased over time, with a sharp surge in early 2025, indicating heightened market participation or volatility.



5.2 Daily Profitability

Graph: Daily Profit/Loss (Bar Chart)

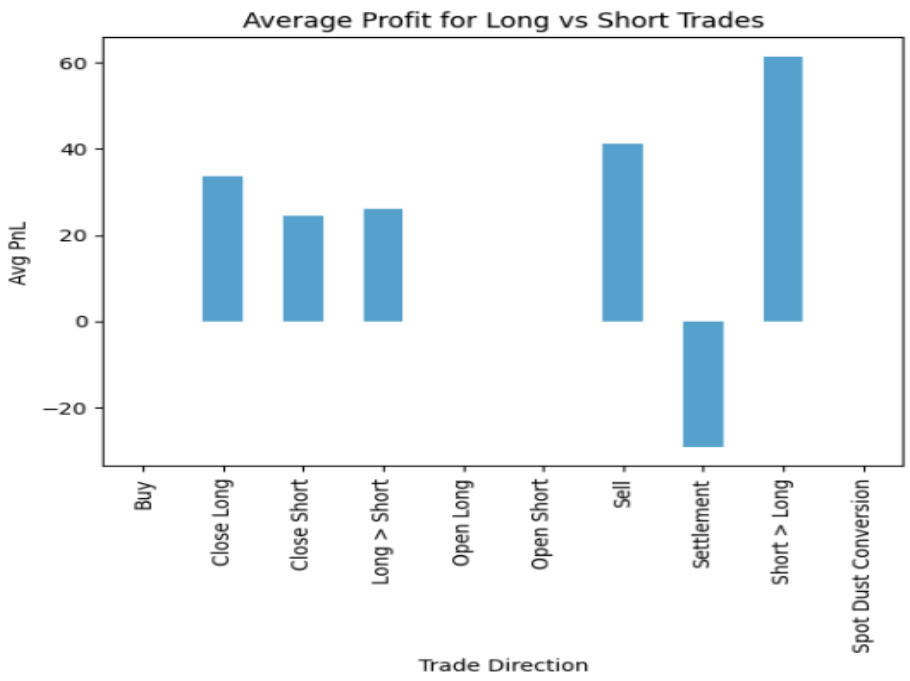
Insight:
Major profits were concentrated on specific days (e.g., 2025-02-19), while earlier periods had low profitability, showing uneven profit distribution.



5.3 Profit by Trade Direction

Graph: Average Profit for Long vs Short

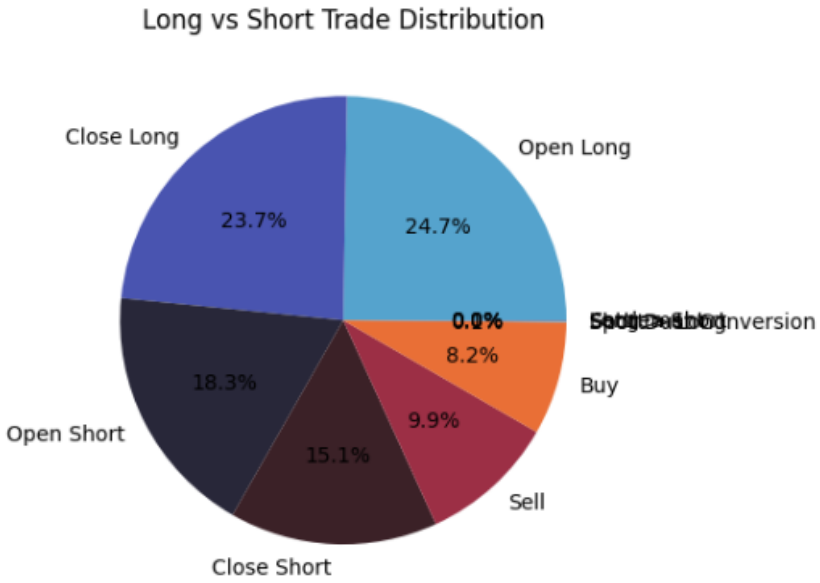
Insight:
Directional trades like Open Long, Close Long, and Sell generated positive average profits, while Settlement resulted in consistent losses.



5.4 Trade Direction Distribution

Graph: Long vs Short Distribution (Pie Chart)

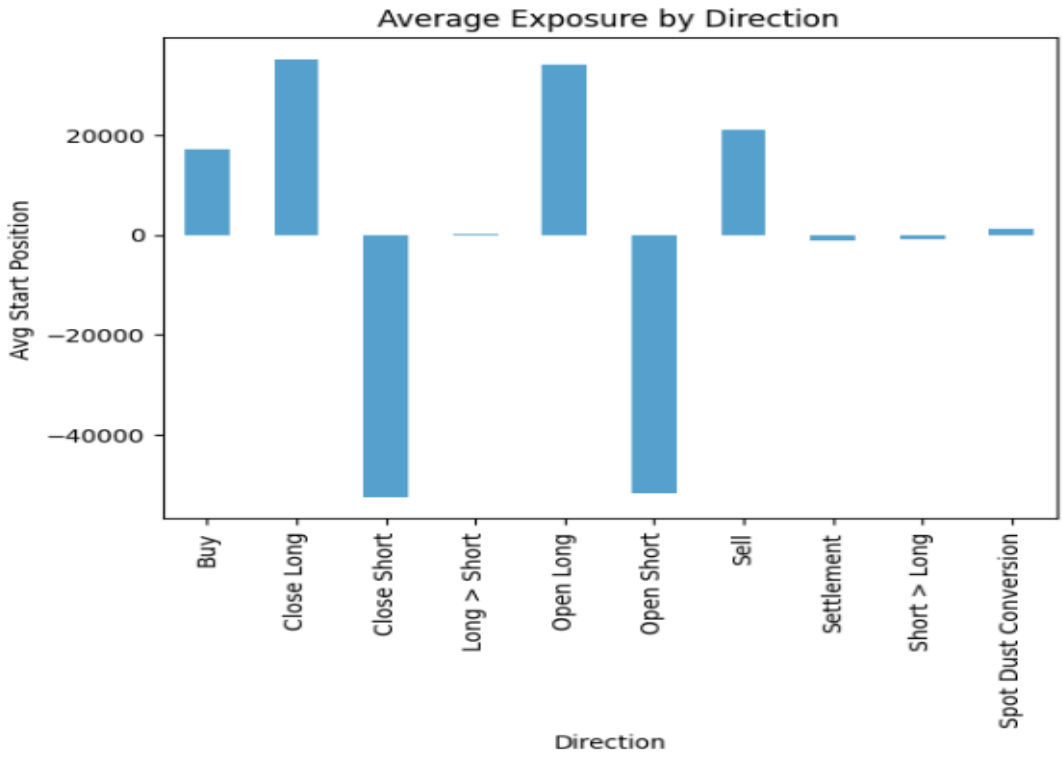
Insight:
Most trades fall under Open Long and Close Long, showing traders frequently manage long positions more actively than shorts.



5.5 Exposure Analysis

Graph: Average Exposure (Start Position) by Direction

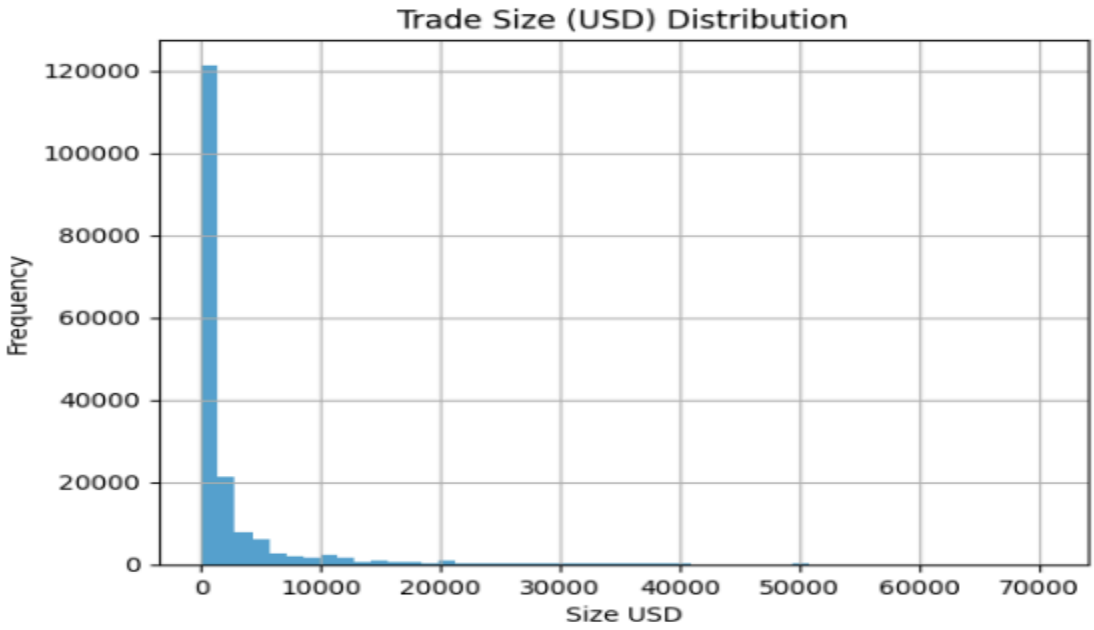
Insight:
Large positive exposures appear in long trades, while large negative exposures occur during short trades, indicating clear risk positioning.



5.6 Trade Size Distribution

Graph: Size USD Distribution (Histogram)

Insight:
Most trades involve small position sizes (< $2,000), with a long tail of occasional high-value trades.

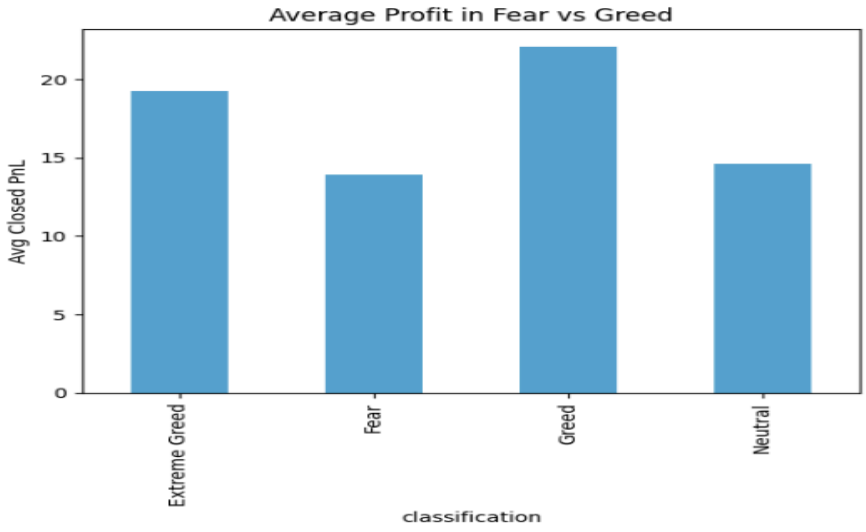


6. Sentiment-Based Analysis (Core Objective)

6.1 Profitability vs Sentiment

Graph: Average Profit in Fear vs Greed

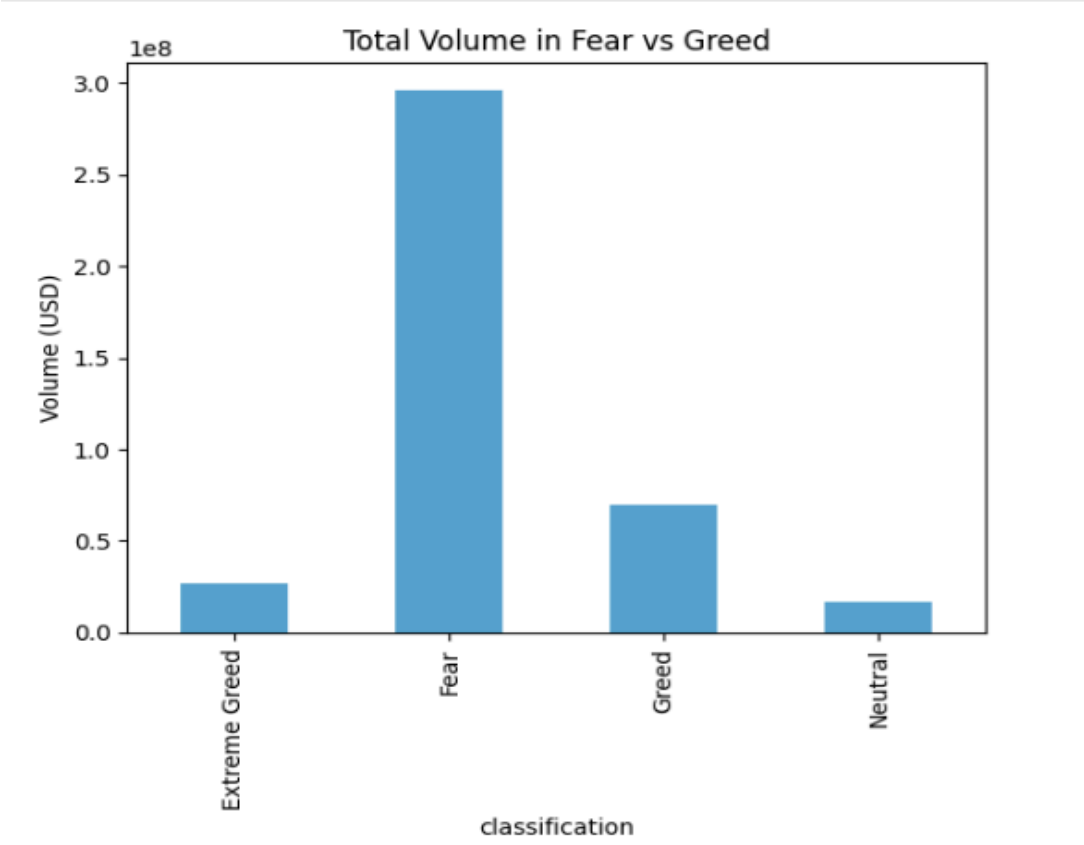
Insight:
Profitability is higher during Greed and Extreme Greed, and lower during Fear, indicating traders perform better when market sentiment is positive.



6.2 Volume vs Sentiment

Graph: Total Volume in Fear vs Greed

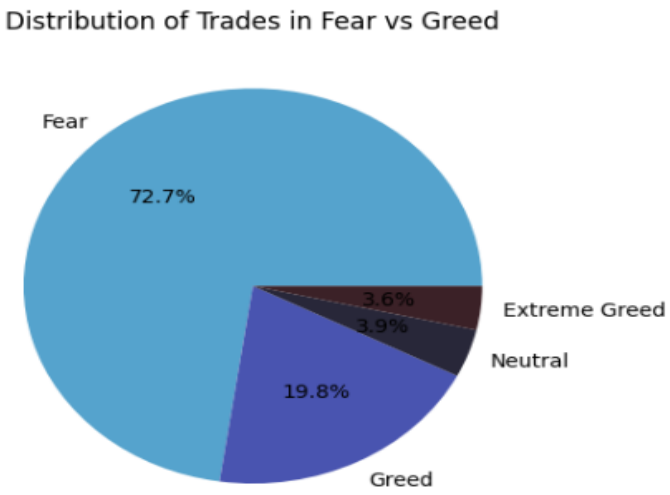
Insight:
Total trading volume is highest during Fear, meaning traders react strongly to negative sentiment—likely due to increased volatility.



6.3 Number of Trades vs Sentiment

Graph: Distribution of Trades (Pie Chart)

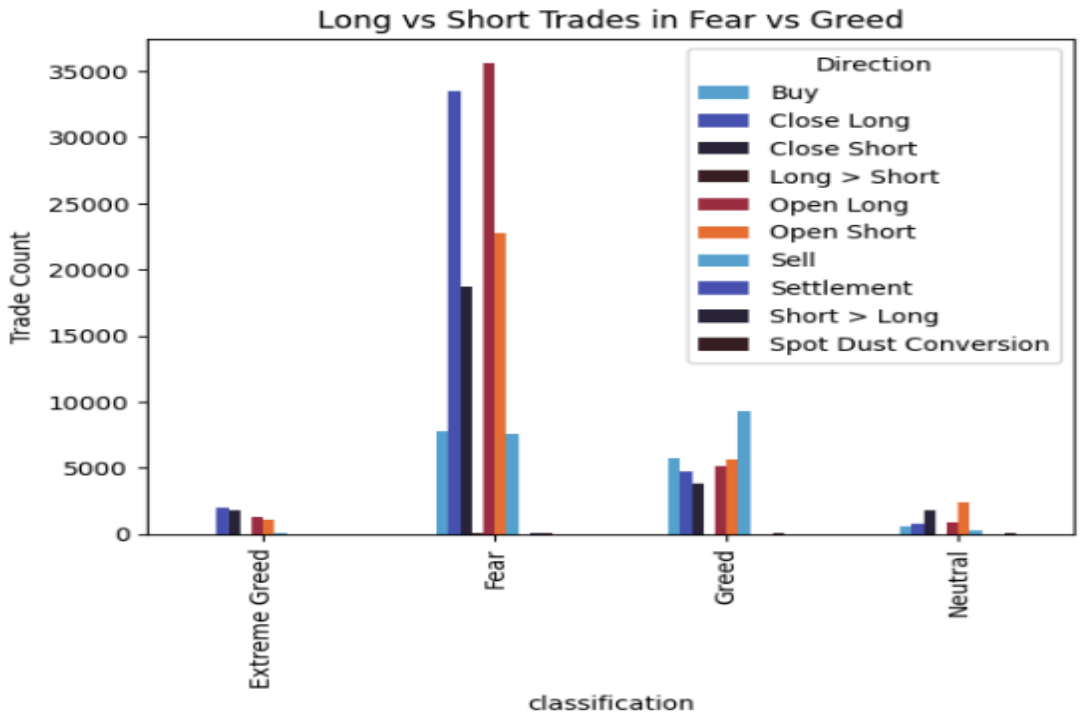
Insight:
Most trades (72%) occur during Fear, showing fear-driven markets attract heavier trading activity.



6.4 Direction Patterns Under Sentiment

Graph: Long vs Short Trades in Fear vs Greed

Insight:
Fear drives high counts of **Close Long**, **Open Short**, and **Close Short**, while Greed shows more balanced long-side activity.



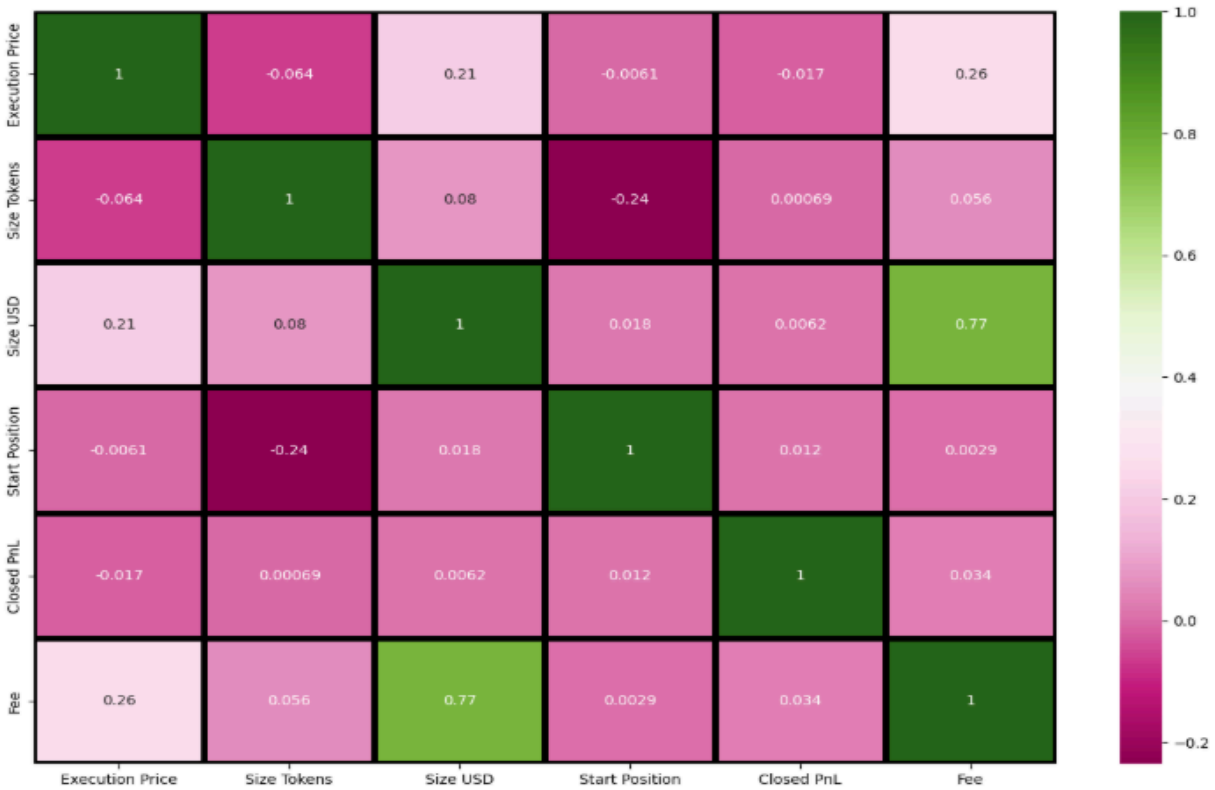
7. Correlation Analysis

Graph: Correlation Heatmap

The correlation analysis reveals that the dataset contains only a few strong numerical relationships. The strongest correlation occurs between Size USD and Fee (0.77), confirming that fees scale with the value of trades. Moderate correlations exist between Execution Price and Fee, and between Size USD and Execution Price, reflecting basic financial relationships. All remaining correlations, including those related to Closed PnL, are weak or near zero. This indicates that profit and risk-taking behaviors are not driven by numeric values like trade size or price but are instead heavily influenced by sentiment conditions and trade direction.

Key Findings:

- **Strongest correlation:**
  - Size USD and Fee (0.77)
- Moderate correlations:
  - Execution Price and Fee
  - Size USD and Execution Price
- PnL has no strong correlation with numerical features → profitability depends more on sentiment and direction, not trade size.



8. Conclusions

- Trader behaviour is strongly influenced by market sentiment.
- Profitability is higher in Greed periods and lower in Fear.
- Trading volume and activity spike dramatically during Fear, showing traders react aggressively to negative emotions.
- Long trades dominate overall, but Fear increases short activity.
- Exposure patterns show traders take large positions in long directions, smaller in short.
- Fees scale directly with trade volume and execution price.
- There is no strong numerical predictor of profit → behavior + sentiment matter more than trade size.