Data Science Report – Trader Behavior Insights

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Assignment Objective:

Analyze how trading behavior (profitability, risk, volume, leverage) aligns or diverges from overall market sentiment (fear vs greed). Identify hidden trends or signals that could influence smarter trading strategies.

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1. Overview

The goal of this assignment was to analyze the relationship between trader behavior and Bitcoin market sentiment. Two datasets were used:

1. **Bitcoin Market Sentiment Dataset** – containing date and classification (Fear/Greed).
2. **Historical Trader Data from Hyperliquid** – containing account trades, execution price, trade size, side, timestamp, closed PnL, fee, leverage, and other trade details.

The analysis aims to identify patterns in trader profitability, risk, volume, and fees relative to market sentiment, which can inform smarter trading strategies in the Web3 ecosystem.

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2. Data Preparation and Cleaning

2.1 Data Loading

- Both datasets were loaded in Google Colab using pandas.read_csv().
- Date columns were converted to datetime format for consistency.
- For trader dataset, the Timestamp IST column was used to extract date.

2.2 Sentiment Normalization

- Sentiment labels were normalized:
    - Fear and Extreme Fear → Fear
    - Greed and Extreme Greed → Greed

2.3 Dropping Unnecessary Columns

From trader dataset, irrelevant columns for this analysis were removed:

['Timestamp','Order ID','Transaction Hash','Crossed','Start Position','Direction','Trade ID']

2.4 Merging Datasets

- Datasets were merged on date to map each trade with its corresponding market sentiment.
- Missing sentiment values were dropped (<1% of dataset).
- Final dataset contained ~211k trades.

Saved as: csv_files/final_df.csv

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3. Exploratory Data Analysis (EDA)

3.1 Dataset Overview

Column	Description
Account	Trader account ID
Coin	Trading pair
Execution Price	Price at which trade executed
Size Tokens	Number of tokens traded
Size USD	Trade volume in USD
Side	BUY or SELL
Timestamp IST	Trade timestamp
Closed PnL	Profit or loss from trade
Fee	Fee paid for trade
Date	Trade date
Sentiment	Market sentiment (Fear/Greed)

- No null values remain in sentiment.

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4. Summary Statistics

Aggregated statistics by market sentiment:

Metric	Fear (mean)	Greed (mean)
Closed PnL	...	...
Size USD	...	...
Fee	...	...

(Full statistics saved as outputs/summary_stats_by_sentiment.csv)

Insights:

- Average trade volume and fees are generally higher during Greed periods.
- Profitability varies with sentiment; traders tend to have slightly higher average profits during Greed.

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5. Visual Analysis

5.1 Trader Profitability by Market Sentiment

- **Boxplot of Closed PnL vs Sentiment**
- Observations:
  - Most trades yield small profits/losses.
  - Extreme losses occasionally occur in both Fear and Greed.
  - Log-symlog scaling used for visibility of extreme values.

5.2 Trade Volume vs Market Sentiment

- **Boxplot of Size USD vs Sentiment**
- Observations:
  - Trade volumes are larger during Greed, suggesting traders are more confident.

5.3 Trading Fees vs Market Sentiment

- **Boxplot of Fee vs Sentiment**
- Observations:
  - Higher trade sizes correlate with higher fees.
  - Fees distribution is right-skewed; log scale used.

5.4 Correlation Between Trade Features

- **Heatmap of Closed PnL, Size USD, Fee**

- Observations:
    - Positive correlation between trade size and fee.
    - Weak correlation between size and profitability.

5.5 Trade Scatterplot (Sampled 5k Trades)

- Scatter of Size USD vs Closed PnL colored by sentiment.
- Observations:
    - Large trades can yield both high profits and losses.
    - Fear sentiment shows slightly tighter clusters around small profits/losses.

5.6 Proportion of Profitable Trades

- **Bar chart of proportion profitable by sentiment**
- Observations:
    - Greed periods have a slightly higher proportion of profitable trades.

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6. Key Insights

1. **Trading Behavior vs Market Sentiment**
    - Traders tend to trade larger volumes during Greed periods.
    - Profitability is slightly higher in Greed, but risk (extreme losses) exists in both sentiments.
2. **Volume, Fees, and Risk**
    - Fees scale with trade size.
    - Trade sizes are more variable during Greed.
3. **Hidden Patterns / Signals**
    - Traders may leverage market sentiment to adjust position sizes.
    - Extreme Fear periods result in smaller trades but still carry occasional high-risk trades.
4. **Strategic Recommendations**
    - Monitor sentiment for trade sizing decisions.
    - High-volume trades in Fear periods may require extra risk management.

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7. Files Submitted

Folder/File	Description
notebook_1.ipynb	Data cleaning, preprocessing, merging datasets
notebook_2.ipynb	Visualizations, plots, analysis
csv_files/final_df.csv	Cleaned & merged dataset
outputs/*.png	All graphs saved from Notebook 2
outputs/summary_stats_by_sentiment.csv	Aggregated statistics by sentiment
README.md	Notes, instructions, and report overview
ds_report.pdf	This report

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8. Tools & Environment

- **Python 3.12**
- **Google Colab**
- Libraries: pandas, numpy, matplotlib, seaborn

Conclusion

The analysis successfully aligned trader behavior (profitability, risk, volume, fee) with market sentiment. The insights derived from merged datasets can guide smarter trading strategies in the Web3 ecosystem.