Trader Behavior vs Market Sentiment Analysis

Web3 Trading Team – Data Science Assignment

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1. Objective

The objective of this analysis is to study the relationship between **trader behavior** and **market sentiment** (Fear vs Greed) using historical trading data from Hyperliquid and the Bitcoin Fear & Greed Index.
The goal is to identify patterns in **profitability, trading volume, and risk behavior** under different market sentiments to derive actionable insights for smarter trading strategies.

2. Datasets Used

2.1 Historical Trader Data (Hyperliquid)

Contains detailed trade-level information such as:

- Execution Price
- Trade Size (Tokens & USD)
- Buy / Sell side
- Closed PnL
- Fees
- Timestamp

2.2 Bitcoin Fear & Greed Index

Provides daily market sentiment classified as:

- **Fear**
- **Greed**

3. Data Preprocessing

Trader Data Cleaning

- Converted `Timestamp IST` into datetime format
- Extracted `date` for merging
- Converted numeric columns (Closed PnL, Size USD, Fee, etc.)
- Removed rows with missing critical values
- Created a profit/loss flag based on Closed PnL

Cleaned trader data was saved as:
csv_files/trader_data_cleaned.csv

Sentiment Data Cleaning

- Standardized column names
- Trimmed extra spaces
- Converted `date` column to `datetime.date` format

4. Exploratory Data Analysis (EDA)

The following analyses were performed and visualized:

4.1 PnL Distribution

- Most trades cluster around small profits or losses
- A long tail indicates few high-profit and high-loss trades
- *Saved as:* outputs/pnl_distribution.png

4.2 Position Size Distribution (USD)

- Majority of trades are small to medium sized
- Few large positions indicate higher risk trades
- *Saved as:* outputs/position_size_distribution.png

4.3 Buy vs Sell Trades

- Trade direction distribution shows trader bias toward certain positions
- *Saved as:* outputs/buy_sell_distribution.png

4.4 Profit vs Loss Trades

- Loss-making trades slightly outweigh profitable trades, highlighting market risk
- *Saved as:* outputs/profit_loss_count.png

5. Sentiment-Based Analysis

Trader data was merged with sentiment data on the **date** column.

5.1 Profitability vs Market Sentiment

- Average PnL was calculated for Fear and Greed periods
- Trades during **Greed** periods show higher average profitability
- Fear periods show higher volatility and inconsistent returns
- *Saved as:* outputs/pnl_vs_sentiment.png

5.2 Position Size vs Market Sentiment

- Traders take **larger position sizes during Greed**
- Smaller and conservative trades dominate during Fear
- *Saved as:* outputs/position_size_vs_sentiment.png

5.3 Trade Frequency vs Sentiment

- Higher number of trades occur during **Greed** phases
- Fear periods show reduced trading activity
- *Saved as:* outputs/trade_count_by_sentiment.png

6. Key Insights

1. **Market sentiment strongly influences trader behavior**

2. Traders are:
    - More aggressive during **Greed**
    - More cautious during **Fear**
3. Higher position sizes correlate with Greed sentiment
4. Profitability improves during Greed but risk exposure also increases
5. Fear periods may offer fewer but potentially strategic opportunities

7. Limitations

- Explicit leverage data was unavailable; position size (USD) was used as a proxy for risk
- Analysis is limited to the available historical period
- External macroeconomic factors were not considered

8. Conclusion

This analysis demonstrates that **market sentiment plays a crucial role in shaping trading behavior**. Understanding sentiment-driven patterns can help traders optimize position sizing, manage risk better, and improve overall strategy performance in Web3 trading environments.

9. Folder Structure Compliance

The project follows the required structure:

```
ds_suraksha_biradar/
├── notebook_1.ipynb
├── notebook_2.ipynb
├── csv_files/
│   └── trader_data_cleaned.csv
├── outputs/
│   └── *.png
├── ds_report.pdf
└── README.md
```