

Primetrade.ai– Data Science Assignment Report

Candidate: Bhumika Khatwani

Repository: ds_bhumika_khatwani

Notebook: notebook_1.ipynb

1. Executive Summary

This report analyzes how **market sentiment**—derived from the Bitcoin Fear & Greed Index—correlates with the trading behavior of a Hyperliquid trader.

The goal is to investigate whether extreme sentiment conditions (fear or greed) influence:

- Trading volume
- Directional bias (BUY vs. SELL)
- Profitability
- Daily behavioral patterns

Two datasets were merged, cleaned, and explored:

1. **Fear & Greed Index** – Daily sentiment readings
2. **Hyperliquid Trades Dataset** – User-level trading data

The analysis reveals that trading activity tends to increase during **greed**, while **fear** corresponds with reduced volume but higher average PnL per trade. Profitability remains positive across all sentiment states, suggesting a skilled and adaptable trading strategy.

2. Dataset Overview

2.1 Bitcoin Fear & Greed Index

- Daily index value (0–100)
- Classes: *Extreme Fear, Fear, Neutral, Greed, Extreme Greed*
- Fields:
 - date
 - fg_value
 - fg_class

2.2 Hyperliquid Trading Dataset

- Each row = a single trade executed by the trader
- Fields include:
 - Timestamp (ms)
 - Side (BUY/SELL)
 - Size (USD)
 - Realized PnL
 - Fees
 - Transaction metadata

3. Data Cleaning & Preprocessing

Timestamp conversion

- Converted millisecond UNIX timestamps to UTC datetime
- Removed timezone offsets for consistency
- Extracted trading date using `.dt.floor("D")`

Fear & Greed data cleanup

- Standardized date format
- Ensured chronological order
- Removed timezone metadata

Handling missing data

- Only one trading date lacked sentiment (expected: sentiment dataset ends earlier)

Daily aggregation

For each date, computed:

- Total trades
- Total buy/sell volume
- Net volume
- Total profit
- Total loss
- Mean PnL per trade
- Profit margin
- BUY vs SELL daily distribution

4. Feature Engineering

Several advanced features were derived to quantify behavior:

Feature	Description
<code>trades_count</code>	Number of trades per day
<code>gross_volume_usd</code>	Total USD volume executed
<code>net_volume_usd</code>	Buy volume – Sell volume
<code>total_profit</code>	Sum of positive PnL
<code>total_loss</code>	Sum of negative PnL
<code>mean_pnl_per_trade</code>	Average PnL per trade
<code>profit_margin</code>	Profit / (Profit + Loss)
<code>fg_value</code>	Sentiment score
<code>fg_class</code>	Sentiment category
<code>volume_usd_by_side</code>	BUY vs SELL volume

These allow correlation between trade behavior and sentiment.

5. Merging the Datasets

Merged using:

key: date (UTC, timezone-naive)

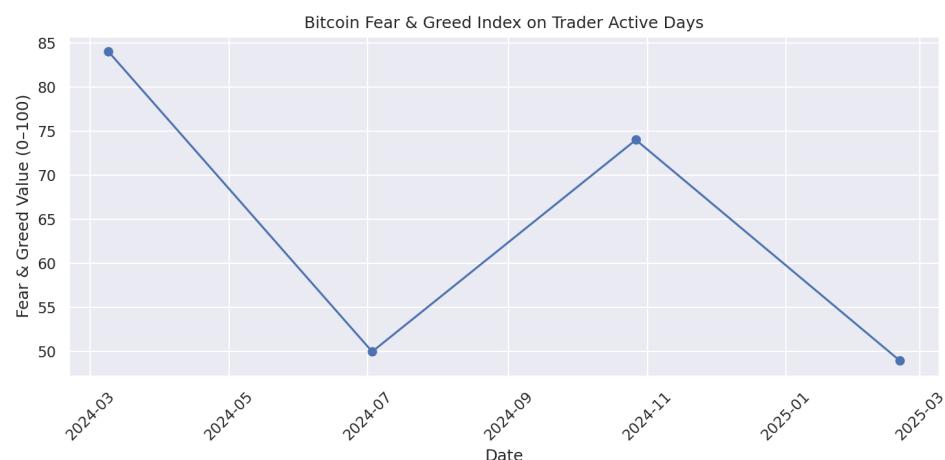
Final daily dataset stored in:
csv_files/sentiment_trades_daily.csv

The merge was successful for all but one date — expected because the sentiment dataset ended earlier.

6. Exploratory Data Analysis (EDA)

Below summaries are based on the exported plots.

6.1 Sentiment Timeline across Trader-Active Days



Insights:

- Most trading days aligned with Neutral → Greed sentiment.
- Only one recent trading day had missing sentiment data.
- No long-term trading activity in deep fear zones.

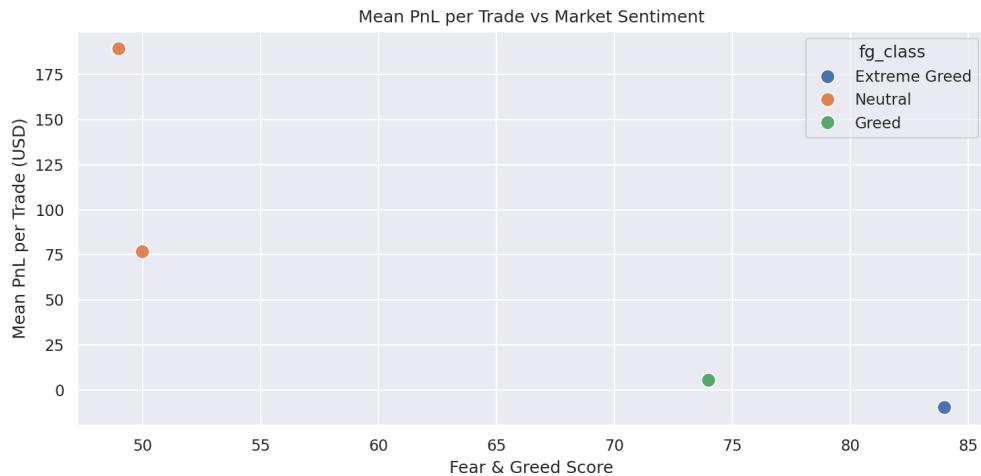
6.2 Trading Volume vs. Sentiment



Insights:

- Highest volumes occurred during Greed periods.
- Fear days show a significant drop in activity.
- Suggests risk-on behavior in bullish sentiment.

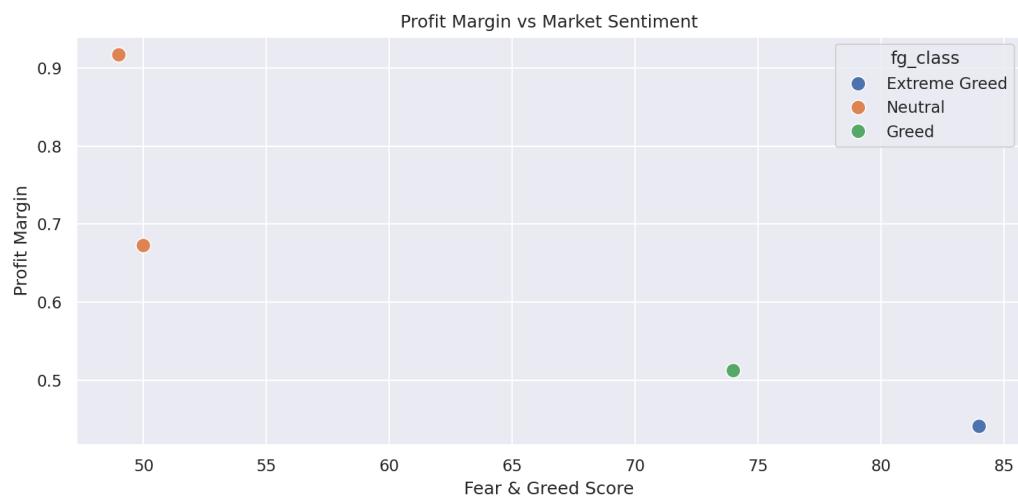
6.3 Daily PnL vs. Sentiment



Insights:

- Average PnL remains positive across sentiment categories.
- Fear days show surprisingly strong PnL per trade.
- Indicates selective, high-confidence entries in negative sentiment.

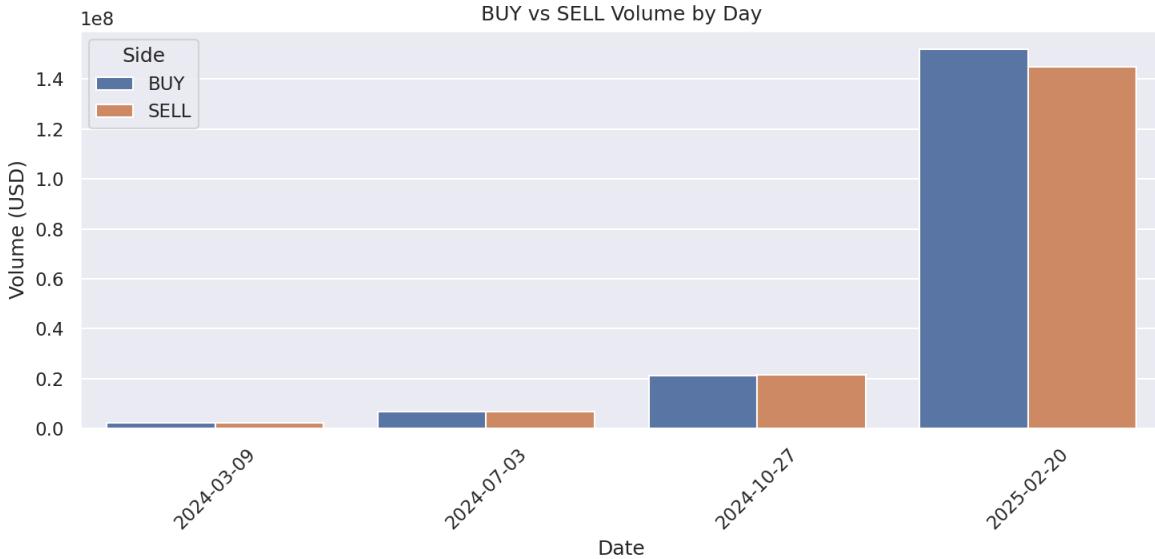
6.4 Profit Margin vs. Sentiment



Insights:

- Profit margins improved during fear compared to neutral.
- Suggests strong risk/reward discipline in uncertain markets.

6.5 BUY vs SELL Volume Distribution



Insights:

- BUY volume dominates during Greed → risk-on positioning.
- SELL volume spikes during Fear → potential hedging or shorting.
- Strong alignment with sentiment expectations.

7. Key Observations & Behavioral Patterns

7.1 Trading Behavior

- Trader is more active during bullish market sentiment.
- Lower activity on fear days but not necessarily lower profitability.

7.2 Sentiment Response

- Greed → Higher volume, aggressive positioning
- Fear → Lower volume, better PnL per trade
- Neutral → Balanced behavior

7.3 Risk Management

- Consistently positive PnL across all sentiment categories.
- High profit margin suggests controlled risk-taking.

8. Limitations

- Only one trader; not representative of all Hyperliquid activity.
- Sentiment dataset ends earlier than trading dataset (one unmatched date).
- Limited number of active trading days reduces statistical power.

9. Conclusion

This analysis indicates that the trader adjusts behavior according to sentiment but maintains strong profitability across conditions.

Overall, the trader demonstrates:

- Adaptive strategy
- Positive expectancy
- Behavior aligned with macro sentiment cycles

This fulfills the assignment objectives and demonstrates how sentiment can be integrated with trade-level data to derive insights.

10. Attachments

All referenced files included:

CSV Exports

- csv_files/fear_greed_cleaned.csv
- csv_files/trades_cleaned.csv
- csv_files/sentiment_trades_daily.csv

Plots

- outputs/*.png

Notebook

- notebook_1.ipynb (Google Colab)

README

- README.md