Report Title: Junior Data Scientist – Trader Behavior Insights
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1. Executive Summary

Purpose: To explore the interplay between market sentiment and individual trader behavior in the crypto market.

Key Findings:

- Traders significantly increase leverage during "Greed" phases, exposing themselves to higher risk.
- "Fear" phases often see lower leverage but can present profitable contrarian opportunities.
- Highly leveraged trades are more volatile, especially during "Greed," suggesting risk amplification.

Recommendations:

- Introduce sentiment-aware risk management tools.
- Promote contrarian strategies during "Fear."
- Monitor leverage distribution in response to sentiment shifts.

2. Introduction

Market sentiment is a leading psychological indicator that reflects trader attitudes. The Fear & Greed Index captures this at a macro level. Our analysis seeks to determine whether trader behavior—particularly leverage usage and profitability—is influenced by this sentiment, with the goal of informing more adaptive trading strategies.

This project aims to examine the relationship between **market sentiment** and **trader behavior**, particularly focusing on **leverage usage** and **profitability (PnL)**. By merging sentiment data with historical trading records, we analyze whether traders tend to act more aggressively (higher leverage) or conservatively under varying emotional climates.

Through this insight, the goal is to inform **data-driven, adaptive trading strategies**—ones that align not just with price and volume data, but also psychological shifts in the market. This could benefit portfolio managers, trading bots, or even retail investors looking to fine-tune their entries and exits based on behavioral finance cues.

3. Dataset Overview

3.1 Bitcoin Market Sentiment Dataset

- **Source**: Alternative.me's Fear & Greed Index
- **Columns**:
  - date – daily index date
  - value – sentiment score from 0 (Extreme Fear) to 100 (Extreme Greed)
  - classification – categorical: "Fear" or "Greed"

3.2 Historical Trader Data from Hyperliquid

- **Source**: Hyperliquid Exchange
- **Columns**:
  - account, timestamp, execution price, size usd, closed pnl, leverage, side, etc.
- This dataset represents individual trades, allowing micro-level behavior tracking.

4. Methodology: Data Cleaning, Preprocessing & Feature Engineering

4.1 Data Loading & Initial Inspection

- Loaded CSV files using Pandas into DataFrames: trader_df and sentiment_df.
- Checked data types and initial completeness.

4.2 Data Cleaning Procedures

- Converted timestamp columns to datetime.
- Coerced closed pnl, size usd, and value to numeric types.
- Dropped rows with nulls in closed pnl, size usd, leverage, timestamp.
- Standardized column names using .str.strip().str.lower().

4.3 Daily Aggregation & Merging for Macro Analysis

- Aggregated trader data to daily granularity using sum of PnL, volume, and count of trades.
- Performed an inner merge with sentiment data on the date column.

4.4 Individual Trade-Level Merging for Micro Analysis

- Added classification to each individual trade based on the date match to perform leverage and PnL analysis by sentiment.

4.5 Feature Engineering

- Derived leverage = size usd / start position when not directly available.
- Created additional flags such as side type, sentiment shift day.

5. Exploratory Data Analysis (EDA)

5.1 Distribution of Market Sentiment

- **Finding**: Greed days slightly outnumber Fear days.
- **Figure 1**: Countplot showing the frequency of Greed vs. Fear classifications.

5.2 Overall Trader PnL and Leverage Distribution

- **Finding**: PnL distribution is highly skewed; most trades are low PnL, few large wins/losses. Leverage has a long right tail.
- **Figure 2**: Histogram of closed pnl.
- **Figure 3**: Histogram of leverage.

6. Core Analysis: Trader Behavior vs. Market Sentiment

6.1 Overall Profitability by Market Sentiment

- **Finding**: Average daily PnL is higher during Greed, but variability is also higher.
- **Figure 4**: Box plot comparing daily total PnL by sentiment.

6.2 Leverage Utilization by Sentiment

- **Finding**: Traders consistently apply higher leverage during Greed periods.
- **Figure 5**: Box plot of leverage by classification.

6.3 Profitability & Risk at Varying Leverage Levels by Sentiment

- **Finding**: Leverage amplifies volatility more during Greed. High leverage trades are more dispersed in outcomes.
- **Figure 6**: Scatter plot of leverage vs. PnL by sentiment.

6.4 Buy vs. Sell Bias and Performance by Sentiment

- **Finding**: During Fear, Buy trades have slightly better average PnL, supporting contrarian behavior.
- **Figure 7**: Bar chart of PnL by sentiment and trade side.

6.5 Trader Activity (Volume, Number of Trades) by Sentiment

- **Finding**: More trades and higher volume observed during Greed.
- **Figure 8**: Bar chart of average daily trading volume by sentiment.
- **Figure 9**: Bar chart of number of trades by sentiment.

7. Advanced Insights & Patterns

7.1 Individual Trader Performance & Sentiment Conformity

- **Finding**: Top traders perform well regardless of sentiment, often showing contrarian behavior.
- **Figure 10**: PnL distribution of top 5 traders by sentiment.

7.2 Impact of Sentiment Shifts on Trading Metrics

- **Finding**: Shift days (Fear → Greed or vice versa) see spikes in activity.
- **Figure 11**: Box plot of trades on sentiment transition days.

7.3 Daily PnL Volatility and Sentiment

- **Finding**: Greed days show higher PnL standard deviation.
- **Figure 12**: Box plot of daily PnL volatility by sentiment.

8. Actionable Trading Strategies & Recommendations

1. **Sentiment-Aware Leverage Control**: Reduce leverage during Greed phases to mitigate drawdown risk.
2. **Contrarian Buy Strategy in Fear**: Buy-side trades during Fear show stronger average profitability.
3. **Monitor Transition Days**: Use shifts in sentiment as signals for increased opportunity or risk.
4. **Volume Scaling**: Reduce activity in Greed despite hype; increase carefully in Fear for asymmetric rewards.

9. Limitations & Future Work

Limitations:

- Single asset (Bitcoin); findings may not generalize.
- No intra-day sentiment granularity.
- Leverage definition derived from assumptions.

Future Work:

- Integrate BTC price action.
- Predictive modeling using sentiment + trade data.
- Time-series analysis of individual traders.
- Include event types for behavioral triggers.

10. Conclusion

This analysis demonstrates a strong relationship between market sentiment and trader behavior, particularly in leverage usage, profitability, and risk exposure. Understanding these patterns can empower Web3 exchanges and traders alike to implement more adaptive, sentiment-driven trading strategies that mitigate downside and exploit contrarian opportunities.