

Soybean meal & Soybean oil MACD peak and trough trading strategy

Ziyi Yang

Department of Finance and Risk Engineering

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Introduction

Overview

Soybean meal is a globally traded commodity that plays a key role in the livestock and food industries. Developing systematic, data-driven strategies helps traders and risk managers reduce reliance on subjective decision-making, improve timing of market entry and exit, and potentially enhance returns while managing risk exposure. This project develops and backtests a trading strategy for soybean meal futures using the MACD indicator, specifically focusing on peak and trough signals. The goal is to evaluate whether systematic technical analysis can improve trading performance compared to passive or discretionary approaches.

Introduction

To whom it matters - Stakeholders

- ▶ **Commodity traders & portfolio managers:** seek profitable and systematic strategies.
- ▶ **Risk management teams:** value evidence-based approaches to mitigate volatility.
- ▶ **Agribusiness analysts:** gain insights into price behavior for hedging and forecasting.

Introduction

Why it matters

The problem it addresses is how to systematically capture short-term and medium-term price trends in agricultural commodities, where volatility, seasonality, and supply-demand shocks often make traditional trading approaches unreliable. A rules-based strategy can provide:

- ▶ More consistent decision-making
- ▶ Improved entry and exit timing
- ▶ Potentially higher returns with risk management

Introduction

Key Results

- ▶ Backtested performance shows how MACD signals align with market trends.
- ▶ Metrics such as returns, volatility, and drawdowns demonstrate the strategy's strengths and limitations.
- ▶ Findings provide a foundation for future refinements, such as parameter tuning or integration with other indicators.

1. Data Ingestion and Overview

Data Exploration

After loading raw data, we extract the most recent 2 years of data from both datasets. Future dates are filtered out (keeps only dates \leq current date)

► Initial Inspection

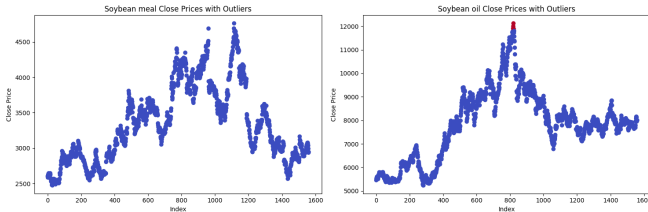
- Displays first 5 rows of both datasets.
- Uses separator lines for clear visual distinction between outputs.

► Metadata Analysis

- Checks basic information about both DataFrames using `'.info()'`.
- Identifies missing values with `'.isna().sum()'`.

1. Data Overview and Preprocessing

Outlier Detection and Visualization - IQR Method



► Diagnostic Summary

- ▶ No drastic change in data within one contract.
- ▶ The diagnostic report using IQR method can not clearly demonstrate the **exact outliers** of data in a time-series.
- ▶ The original data fits the daily trading data well showing enough consistency. No need to winsorize or drop the outliers.

2. Technical Indicator - MACD

- ▶ **Moving Averages**
 - ▶ **MA5:** 5-day simple moving average
 - ▶ **MA20:** 20-day simple moving average
 - ▶ **MA60:** 60-day simple moving average
- ▶ **Exponential Moving Averages**
 - ▶ **EMA3:** 12-period EMA (misabeled as EMA3)
 - ▶ **EMA10:** 26-period EMA (misabeled as EMA10)
- ▶ **MACD Components**
 - ▶ **MACD Line:** Difference between EMA3 and EMA10 (12-period and 26-period EMAs)
 - ▶ **Signal Line:** 9-period EMA of the MACD line
 - ▶ **MACD Histogram:** Difference between MACD and Signal lines

2. Technical Indicator - MACD

Technical Indicator Calculation and Visualization

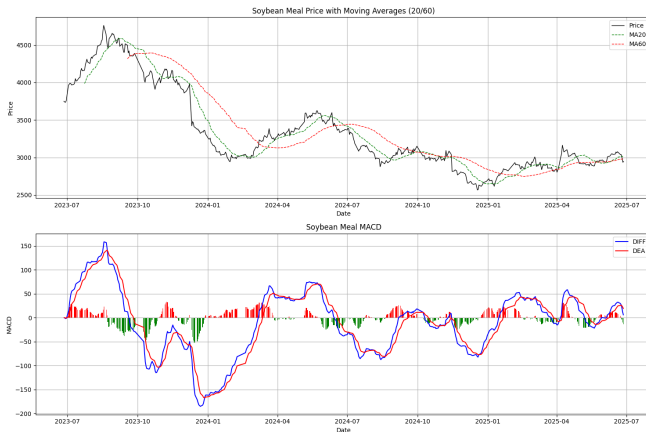


Figure 1: Soybean Meal Price, Moving Average and MACD

2. Technical Indicator - MACD

Technical Indicator Calculation and Visualization

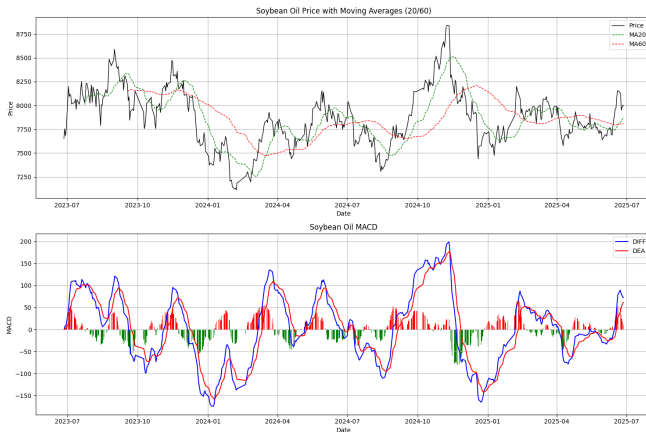


Figure 2: Soybean Oil Price, Moving Average and MACD

3. Data Feature Engineering - LSTM + CNN + Transformer

Dataset Partitioning and Feature scaling

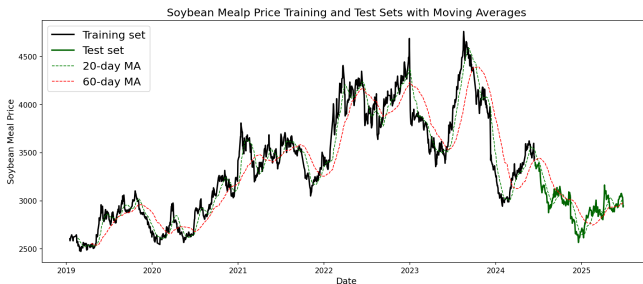


Figure 3: Construct the training set and the test set respectively

3. Data Feature Engineering - LSTM + CNN + Transformer

Define the CNN, LSTM, Transformer models

- ▶ **CNN:** It is used for extracting local features and is particularly suitable for processing local patterns in images or time series.
- ▶ **LSTM:** It is used to capture long-term dependencies and is suitable for handling time series data.
- ▶ **Transformer:** It is used to capture global dependencies, especially through the self-attention mechanism, and can process sequential data in parallel.

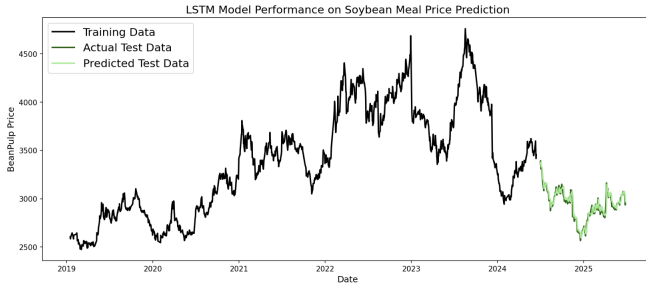
3. Data Feature Engineering - LSTM + CNN + Transformer

Model Evaluation

- ▶ **Loss:** The loss function measures the average difference between predicted values and actual values, based on the optimization objective defined during training (e.g., Mean Squared Error, Mean Absolute Error).
- ▶ **MAPE (Mean Absolute Percentage Error):** MAPE measures the average absolute percentage difference between actual values and predicted values.
- ▶ **Accuracy (based on MAPE):** Translates error into an intuitive “accuracy” score (e.g., 95% accuracy if $\text{MAPE} = 0.05$).

3. Data Feature Engineering - LSTM + CNN + Transformer

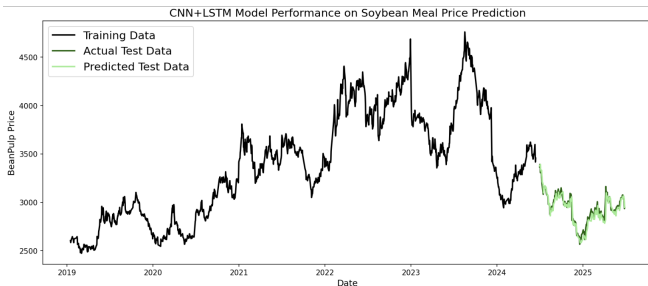
LSTM Performance



- ▶ LSTM Test Loss: 0.000331
- ▶ LSTM Test MAPE: 0.071291
- ▶ LSTM Test Accuracy: 0.928708

3. Data Feature Engineering - LSTM + CNN + Transformer

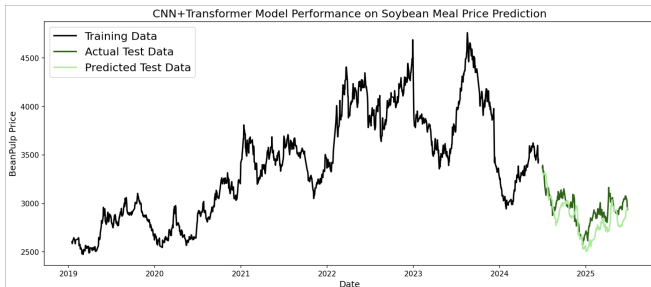
CNN + LSTM Performance



- ▶ CNN+LSTM Test Loss: 0.000402
- ▶ CNN+LSTM Test MAPE: 0.082096
- ▶ CNN+LSTM Test Accuracy: 0.917903

3. Data Feature Engineering - LSTM + CNN + Transformer

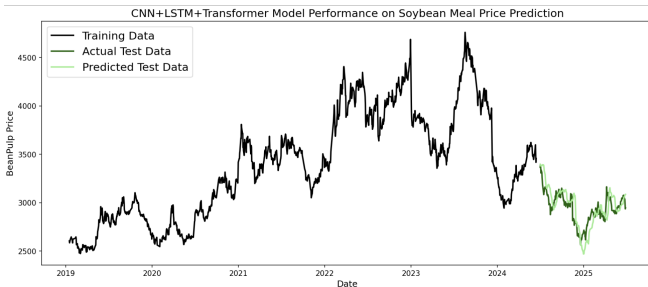
CNN + Transformer Performance



- ▶ CNN+Transformer Test Loss: 0.003407
- ▶ CNN+Transformer Test MAPE: 0.257585
- ▶ CNN+Transformer Test Accuracy: 0.742414

3. Data Feature Engineering - LSTM + CNN + Transformer

CNN + Transformer + LSTM Performance



- ▶ CNN+LSTM+Transformer Test Loss: 0.001848
- ▶ CNN+LSTM+Transformer Test MAPE: 0.193641
- ▶ CNN+LSTM+Transformer Test Accuracy: 0.806358

3. Data Feature Engineering - LSTM + CNN + Transformer

Future Price Prediction (Hybrid Models)

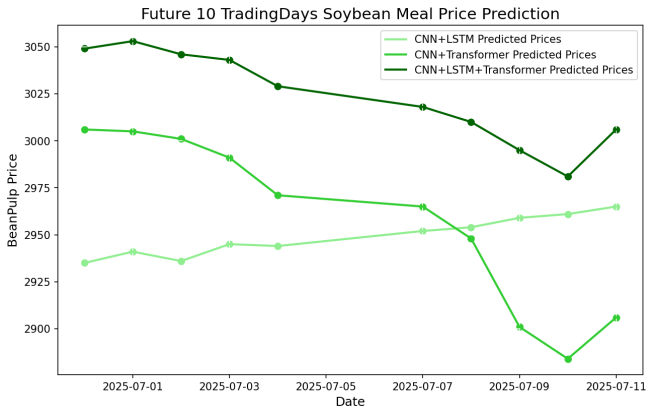


Figure 4: Comparison between Hybrid Models

4. Strategy Building - MACD peak and trough

► Trend Information

- When $MACD > 0$, the short-term moving average (MA) is above the long-term MA, indicating an upward price tendency. When $MACD < 0$, the short-term MA is below the long-term MA, indicating a downward price tendency.

► Momentum Changes

- The MACD histogram measures the strength or weakness of momentum. When the histogram changes from positive to negative, it often signals a potential trend reversal in price.

► Peak-Trough Features and Price Reversals

- Local **peaks of the MACD** correspond to momentum tops during upward price movements.
- Local **troughs of the MACD** correspond to momentum bottoms during downward price movements.

4. Strategy Building - MACD peak and trough

Position Sizing

▶ Trading Execution

- ▶ Separate 50,000 accounts for soybean meal and oil.
- ▶ Tracks positions, prices, profits, and consumption.
- ▶ Calculates ATR for both commodities

▶ Risk Management

- ▶ Position sizing based on account equity.
- ▶ Commission costs (1.5 per lot).
- ▶ Rest period avoidance
- ▶ Regular profit withdrawals (every 14+ days)

4. Strategy Building - MACD peak and trough

Trading Entry Logic

MACD histogram troughs + trend confirmation + breakout

- ▶ Take the High/Low of "trough" as the breakthrough price
- ▶ **Upward trend:** Only go long; If the highest price of the next day is greater than or equal to the trough high point → triggering a long position to break through and open a position, the entry price = the high point trough day
- ▶ **Downward trend:** Only go short; If the lowest price of the next day is less than or equal to the low point of the trough day → the short position breaks through and opens, the entry price = the low point of the trough day

4. Strategy Building - MACD peak and trough

Position risk control and exit

A. ATR trailing stop

- ▶ **Update the anchor price**
 - ▶ **Long position:** if `current_close` reaches a new high, then `last_trade_price = current_close`;
 - ▶ **Short position:** if `current_close` reaches a new low, then `last_trade_price = current_close`.
- ▶ **Calculate the stop-loss price for the root**
 - ▶ **Long position:** `stop = max(last_trade_price - ATR, current_close - ATR)`; If `next_day_close` \geq `stop` \rightarrow close position
 - ▶ **Short position:** `stop = max(last_trade_price + ATR, current_close + ATR)`; If `next_day_close` \leq `stop` \rightarrow Close position

4. Strategy Building - MACD peak and trough

Position risk control and exit

B. The MACD histogram "peak" exit

- ▶ Let the histogram series be denoted by H_t (the value on day t). A "peak" is detected as a local maximum:

$$H_{t-1} < H_t \quad \text{and} \quad H_t > H_{t+1}.$$

- ▶ When a peak occurs:
 - ▶ Ignore the stop; exit directly at the next day's close (`next_day_close`).
 - ▶ P&L and fee calculation, capital logging, and consumption-withdrawal follow the same procedure as in Sections A.4–A.5 (only the trigger differs).

5. Trading Strategy Evaluation

Consumption-Withdrawal Mechanism (profit skim)

- ▶ After each position is closed, check whether the time since the last withdrawal is ≥ 14 days.
- ▶ Compute the withdrawable amount from the current accrual period: based on the change from `period_start_capital` to capital (e.g., 30% of period profit with a 5,000 floor and a 10,000 cap).
- ▶ If the computed amount > 0 , withdraw that amount from capital:
 - ▶ Log it into `total_consumption_*` and `consumption_history_*`.
 - ▶ Update `period_start_capital` to the current capital.
 - ▶ Rationale: this is a profit distribution / capital segregation rule to lock in realized gains and reduce giveback risk.

5. Trading Strategy Evaluation

Capital Curve

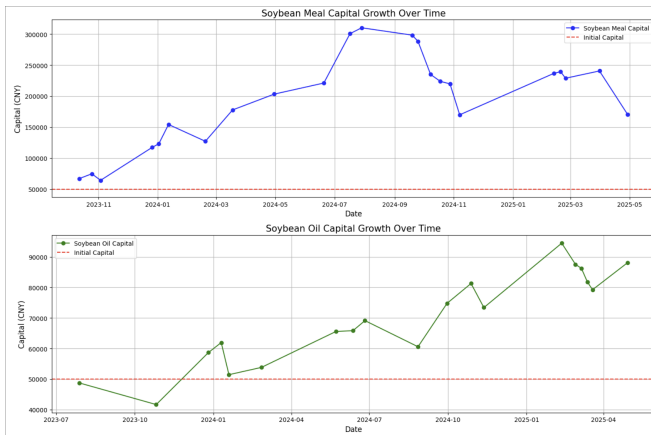


Figure 5: Backtesting on Soybean Meal and Soybean Oil

5. Trading Strategy Evaluation

Backtest Summary

Table 1: Backtest Summary

Metric	Soybean meal	Soybean oil
Initial capital	50 000.00	50 000.00
Final funds	170 599.40	88 110.00
Total revenue	185 139.50	54 925.00
Total consumption withdrawal	63 449.60	16 680.00
Annualized rate of return	84.72%	32.75%

5. Trading Strategy Evaluation

Performance metrics (Sharpe, Max Drawdown, Win Rate)

Table 2: Performance Metrics

Metric	Soybean Meal	Soybean Oil
Sharpe Ratio (annualized)	4.305	4.418
Max Drawdown	-45.23%	-16.98%
Win Rate	54.55%	55.56%

1.1 Data & Instruments

- ▶ **Instrument series:** Continuous futures for Soybean Meal (and Soybean Oil for comparison) built with a **volume/open-interest based roll** and **no price back-adjustment gaps** (or adjusted consistently).
- ▶ **Data fields:** OHLCV present; timestamps are **trading-day close in local exchange timezone**, strictly increasing and de-duplicated.
- ▶ **No survivorship bias; delistings/contract changes** handled through the roll logic.
- ▶ **Currency:** All PnL and capital tracked in **CNY**; no FX conversion applied unless explicitly configured.

1.2 Strategy Logic

- ▶ **Execution timing:** Signals generated on bar t are **executed on bar $t+1$** at the **open** (or close, but keep it consistent).
- ▶ **Positioning:** Fixed notional (or fixed units) per signal without dynamic leverage unless configured.
- ▶ **Transaction costs:** Commission and slippage are **assumed constant** per trade (bps or per contract). If unset, defaults to **0** (backtest-optimistic).

1.3 Metrics & Conventions

- ▶ **Returns frequency:** Equity curve sampled at the strategy's bar frequency (default **daily**).
- ▶ **Sharpe Ratio:** Uses **simple returns**, annualized with **252** periods/year; **risk-free rate** = 2% unless overridden.
- ▶ **Max Drawdown (MDD):** Peak-to-trough **on equity curve** (percentage).
- ▶ **Win Rate:** If trade PnLs provided → **trade-level** win rate; else falls back to **positive-bar** percentage.
- ▶ **Annualized Return:** *User formula:* assumes **2 years** for comparability with prior outputs. *CAGR:* computed from actual start/end dates.

1.4 Capital & Withdrawals

- ▶ **Initial capital** fixed and known at start.
- ▶ **Consumption withdrawals** (e.g., min 5,000 / max 50,000 CNY lines) are **exogenous** to the signal logic and reduce equity when triggered; they **do not retroactively alter signals**.

1.5 Backtest Hygiene

- ▶ **No look-ahead:** Indicators use **past and current bar only**.
- ▶ **No data snooping:** MACD parameters not repeatedly tuned on the same sample without out-of-sample testing.
- ▶ **Stable calendar:** Exchange holidays and limit-up/limit-down sessions are treated as **no-trade** (or skipped) consistently.

2. Validation Checklist (pre-merge)

- ▶ Indicators computed with **no future leakage** (unit tests for index alignment).
- ▶ **Costs/slippage** applied and sensitivity run recorded.
- ▶ **Sharpe/MDD/WinRate** recomputed after costs; values within expected bands.
- ▶ **Equity curve** visually inspected around **roll dates**.
- ▶ **Walk-forward** or **out-of-sample** slice reported.
- ▶ Re-run on **alternative data vendor** (spot check).
- ▶ Results saved to reports/backtests/* with **timestamp + config snapshot**.