

Project 6: INDICATOR EVALUATION

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1 INTRODUCTION

Given a portfolio, explore the theoretically optimal trading strategy that can earn maximum return. Implement five technical indicators to generate trading signals, which can be combined to form an applicable trading strategy.

2 INDICATORS

We can divide indicators into three categories:

- Momentum indicators measure the fluctuations or momentum of a stock and determine the rate of reversing market.
- Trend following indicators measure the direction and strength of market trends.
- Volatility indicators measure how much price fluctuates around a mean.

Table 1 — Indicator categories.

Momentum	Trend	Volatility
Stochastic	Moving average	Bollinger bands
RSI	MACD	
CCI	ADX	
Rate of Change		
Percentage Price		

Individual indicators are weakly predictive. Combination of them can form applicable trading strategies. While indicators from same categories may give you duplicate information. It is not only redundant but can also be misleading, ends up overemphasizing information. In order to get complimentary signals, combine indicators from different categories.

2.1 Stochastic oscillator

The Stochastic Oscillator is a momentum indicator that shows the location of the closing price relative to the high and low range over a certain period of time.

The common default setting is Stochastic(14,3):

$$\%K = \frac{C - Low}{High - Low} \times 100$$

Where:

C = the most recent closing price

Low = 14-period moving min of closing price

High = 14-period moving max of closing price

%K = stochastic indicator value

%D = 3-period moving average of K

Stochastic values range from 0 to 100. When the value is close to 0 or 100, there is strong momentum in one direction. Which the momentum may not be sustainable. Therefore it can indicate overbought and oversold situations.

- Stochastic values > 80 → Overbought (look to sell)
- Stochastic values < 20 → Oversold (look to buy)

Combining %K and %D to indicate impending reversal

- %K crossing below %D → Sell signal
- %K crossing above %D → Buy signal

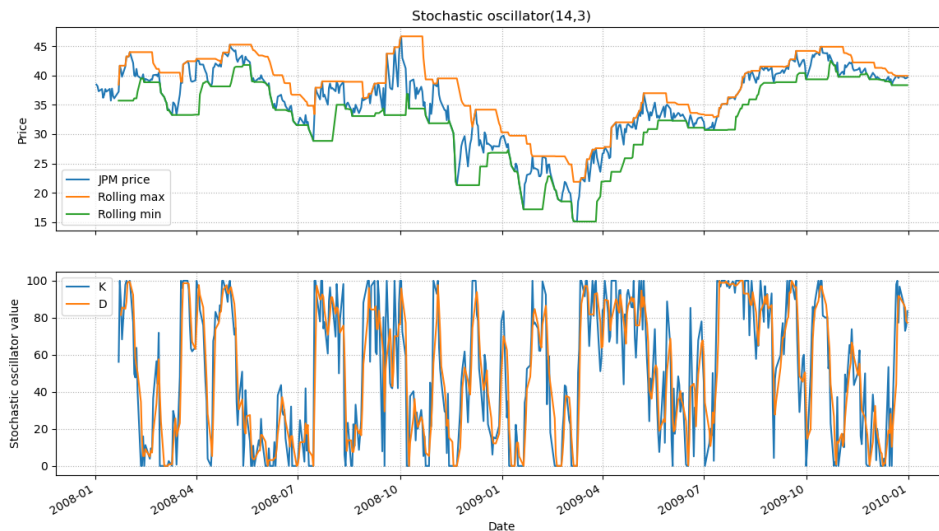


Figure 1—Stochastic(14,3) results.

Divergence between Stochastic values and trending price action is also reversal signal.

2.2 RSI

The RSI (relative strength index) is another momentum indicator that measures the magnitude of recent price changes to indicate overbought or oversold conditions.

The common default setting is RSI(14):

$$RSI = 100 - \frac{100}{1 + RS}$$

$$RS = \frac{\text{Average gain}}{\text{Average loss}}$$

Where:

Average gain = 14-period moving average percentage gain

Average loss = 14-period moving average percentage loss

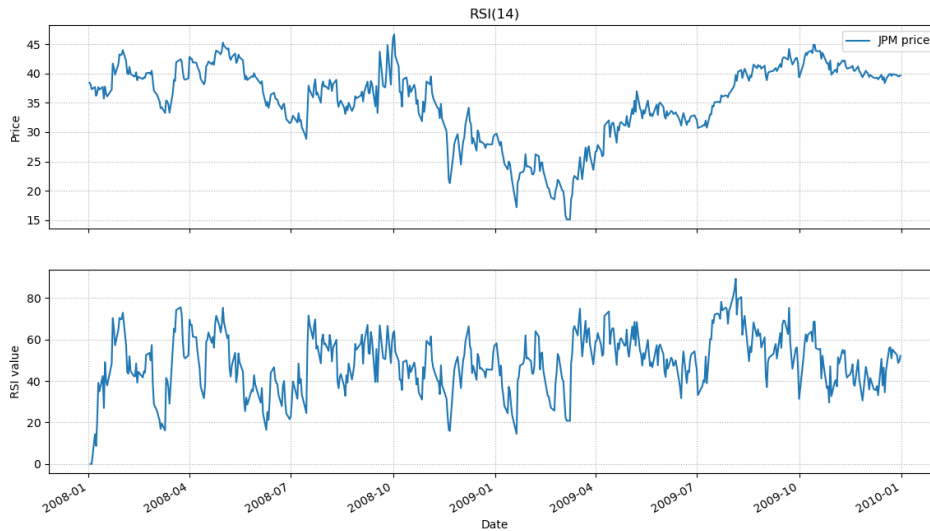


Figure 2 — RSI(14) results.

RSI values range from 0 to 100. It measures the speed of price movement and compares the candlesticks (bullish vs. bearish) and the size of candlesticks. The RSI forecasts an upcoming reversal sooner than almost any other indicators.

- RSI values > 70 → Overbought (look to sell)
- RSI values < 30 → Oversold (look to buy)

Although RSI and Stochastic oscillator are both momentum indicators, they each have different underlying methods. Stochastic works best in consistent trading ranges while RSI measures the price strength. Therefore, they can be used cooperatively.

2.3 EMA

EMA (exponential moving average) is a variant of moving average that places more weight on most recent data points.

$$EMA_{Today} = Value_{Today} \times \frac{Smoothing}{1 + Days} + EMA_{Yesterday} \times \left(1 - \frac{Smoothing}{1 + Days}\right)$$

Where:

Value = price

Days = lookback days

Smoothing = factor controls how recent observations are valued

EMA measures a weighted average closing price and is more responsive to recent price changes. The EMA(8) and EMA(20) are used as indicators for short-term trends, EMA(50) and EMA(200) tend to be used more for long-term goal. The basic approach is to use price / EMA to indicate the market sentiment.

- Price / EMA > 1 → Bullish
- Price / EMA < 1 → Bearish

The slope of the EMA can also be informative

- EMA is sloping up → Bullish
- EMA is sloping down → Bearish

Compare to SMA, EMA does alleviate the negative impact of lags to some extent. While as EMA responds more to recent market prices, it produces more reversal signals and become less reliable.

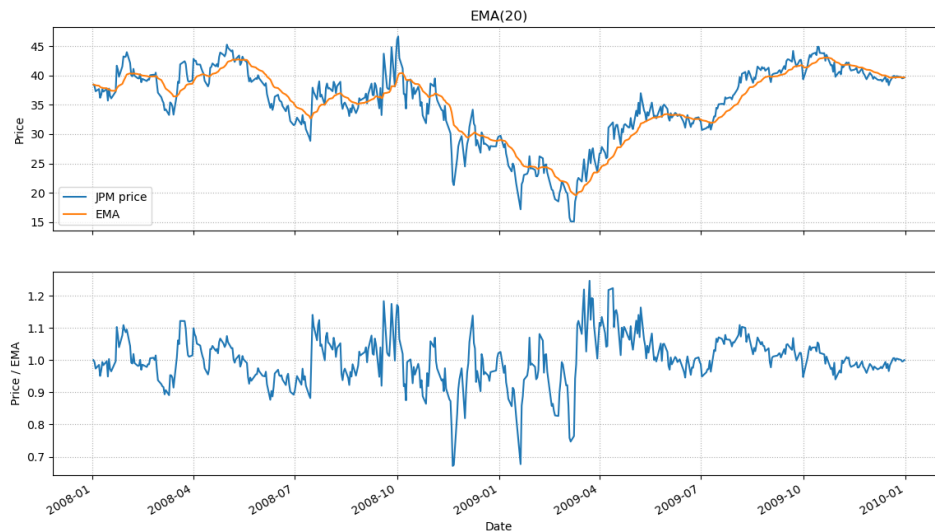


Figure 3 — EMA(20) results.

2.4 MACD

MACD (moving average convergence divergence) is a trend following momentum indicator. By measuring the differences between two moving averages to track both trend and momentum.

The common default setting is MACD(12,26,9):

$$MACD = EMA_{12} - EMA_{26}$$

Where:

EMA_{12} = 12-period EMA

EMA_{26} = 26-period EMA

Signal line = 9-period EMA of MACD

The signal line acts as a trigger for trade decisions.

- MACD above signal line → Bullish

- MACD below signal line → Bearish

This relationship can be visualized by the MACD histogram. The histogram values are positive when MACD is above the signal line and negative when MACD is below the signal line. The histogram can also show the momentum:

- High positive histogram values → Strong bullish momentum
- High negative histogram values → Strong bearish momentum

While since MACD values are unbounded, it cannot be used to define overbought and oversold regions.

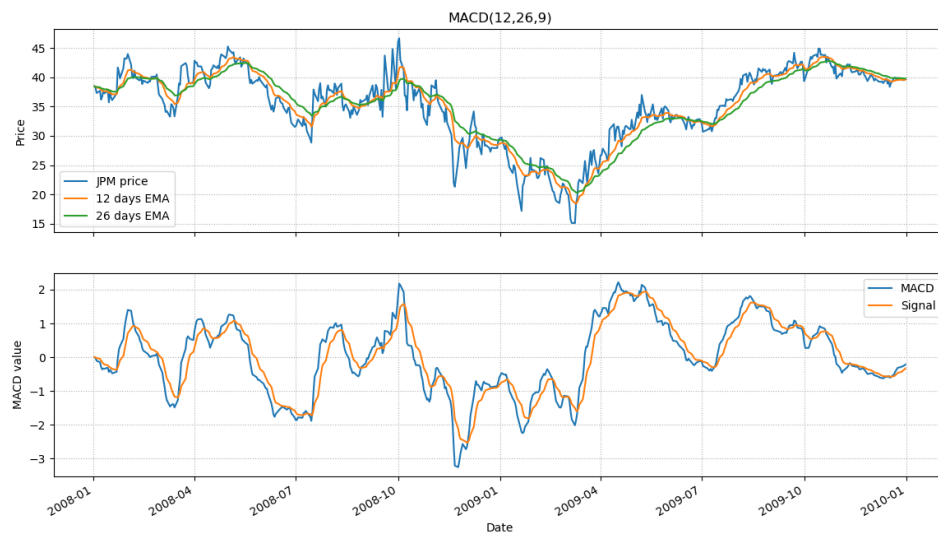


Figure 4 – MACD(12,26,9) results.

2.5 Bollinger bands

Bollinger bands is the most commonly used volatility indicators. Wider bands show a high volatility market and narrower bands show a low volatility market.

The common default setting is Bollinger(20,2):

$$upper_band = SMA + n * std$$

$$lower_band = SMA - n * std$$

$$BB = \frac{Price - SMA}{n \times std}$$

Where:

SMA = 20-period moving average

std = 20-period moving standard deviation

n controls the width of the bands, usually choose 2

BB = Bollinger bands value

Bollinger bands are composed by SMA, upper band and lower band. When the price is close to upper or lower band, it may indicate overbought or oversold situations.

For a range trade,

- Price tags upper band → Look to sell
- Price tags lower band → Look to buy

For a break-out trade,

- Price closes above upper band → Look to buy
- Price closes below lower band → Look to sell

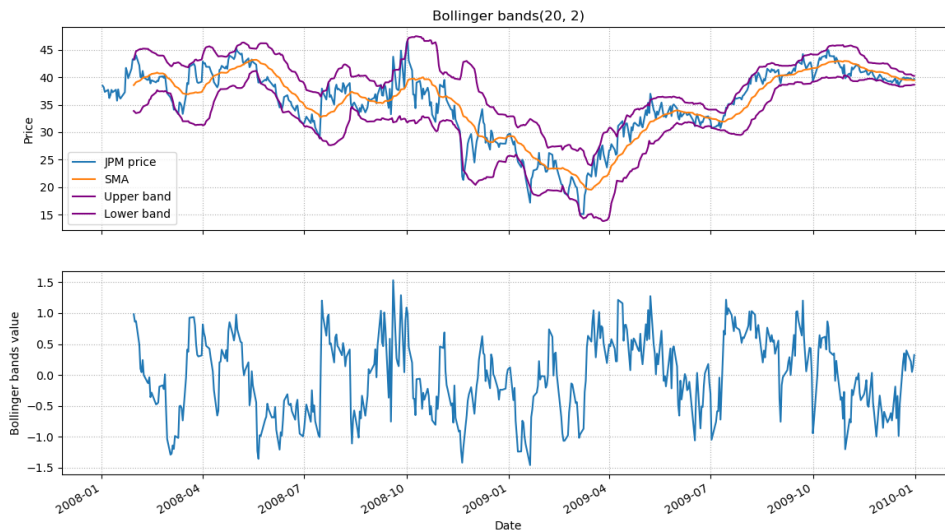


Figure 5—Bollinger bands(20) results.

3 THEORETICALLY OPTIMAL STRATEGY

The given portfolio starts with \$100,000 cash and trades on JPM within time period from January 1, 2008 to December 31, 2009. The theoretically optimal strategy only allows positions of 1000 shares long, 1000 shares short and 0 shares. Therefore, up to 2000 shares can be traded at a time. The commission and impact are \$0.00 and 0.00 for each transaction.

Since I'm allow to peek into the future, my trading decision is determined by tomorrow's closing price. If price drops, I sell up to 2000 shares to achieve 1000 shares short. If price goes up, I buy up to 2000 shares to achieve 1000 shares long. Otherwise I hold the current position. In this way, I can make profit on every price change and earn maximum return.

Another portfolio starting with \$100,000 cash, investing in 1000 shares of JPM and holding that position is treated as benchmark.

Table 2 — Statistics of TOS versus Benchmark.

	Cumulative returns	Std of daily returns	Mean of daily returns
Benchmark	0.012300	0.017004	0.000168
TOS	5.786100	0.004548	0.003817

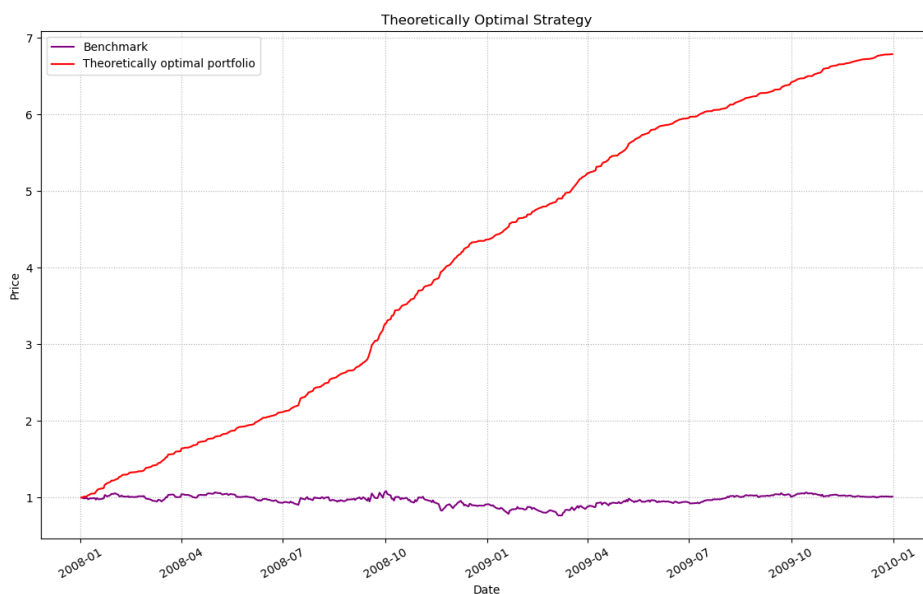


Figure 6 — TOS performance versus Benchmark.