

# Project 6: Indicator Evaluation and Theoretically Optimal Strategy (TOS)

Mohammed Fahad  
mfahad7@gatech.edu

**Abstract**—This report evaluates five technical indicators: Exponential Moving Average (EMA), Golden Cross, MACD, RSI, and Money Flow Index. These indicators are implemented and applied to the JPM stock data (from January 2008 to December 2009). Additionally, the report explores a Theoretically Optimal Strategy (TOS) for trading, presenting its performance alongside the benchmark. Both cumulative returns and risk are compared to assess the efficiency of TOS.

## 1 INTRODUCTION

This project is focused on implementing five market indicators and applying them to stock price data. These indicators provide actionable insights into buy/sell signals, which can later be used in strategy development. Furthermore, a Theoretically Optimal Strategy (TOS) is devised to establish the best possible portfolio performance, assuming perfect market foresight.

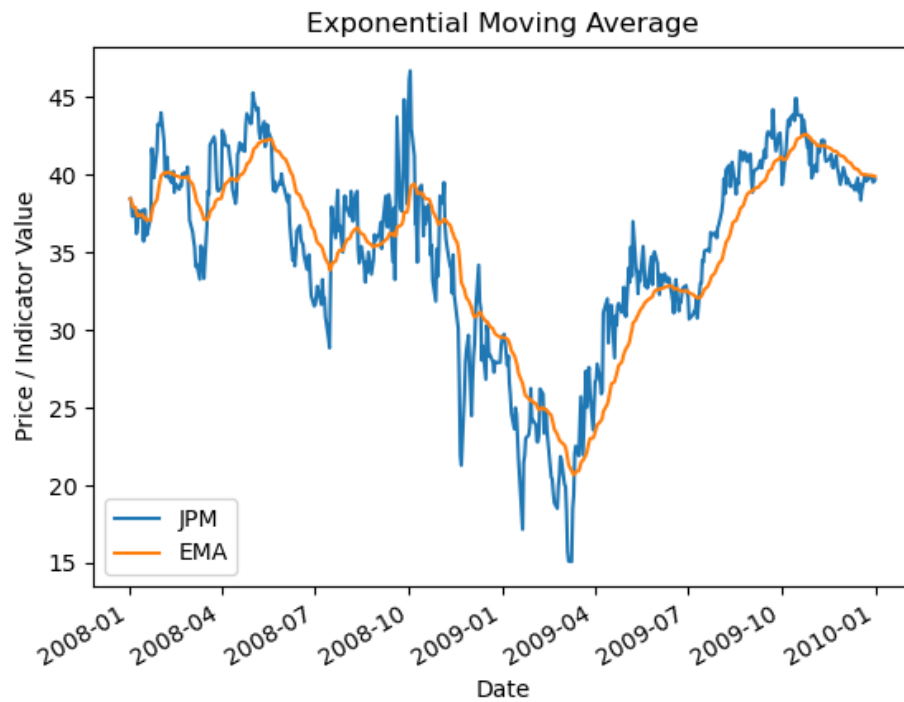
## 2 INDICATORS

The following technical indicators were implemented and analyzed:

### 2.1 Exponential Moving Average (EMA)

The Exponential Moving Average (EMA) is a weighted average of past prices where recent prices are given more weight. This makes the EMA more responsive to recent price movements compared to the Simple Moving Average (SMA). The formula for EMA is:

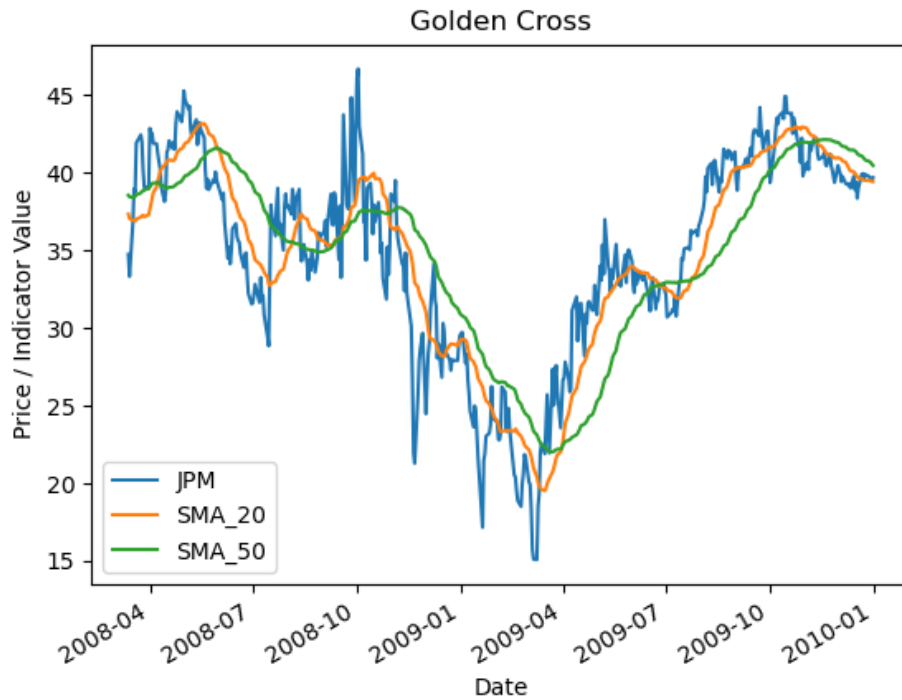
$$EMA = \frac{Price_t - EMA_{t-1}}{N + 1} + EMA_{t-1}$$



*Figure 1*—Exponential Moving Average (30-day period) for JPM stock from January 2008 to December 2009.

## 2.2 Golden Cross

The Golden Cross is a crossover of a short-term moving average above a long-term moving average, typically considered a bullish signal. Here, the 20-day and 50-day SMAs were used.



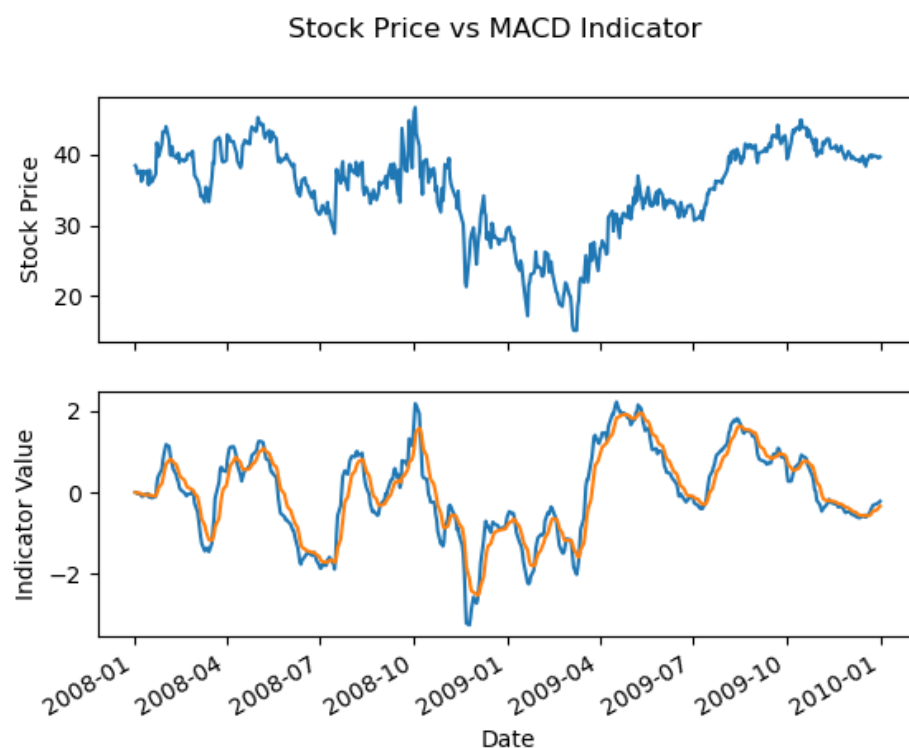
*Figure 2*—Golden Cross (SMA 20 vs SMA 50) for JPM stock. A bullish signal is generated when the SMA 20 crosses above the SMA 50.

### 2.3 MACD (Moving Average Convergence Divergence)

MACD is a trend-following momentum indicator that shows the relationship between two moving averages of a stock's price. The formula for MACD is:

$$\text{MACD} = \text{EMA}_{12} - \text{EMA}_{26}$$

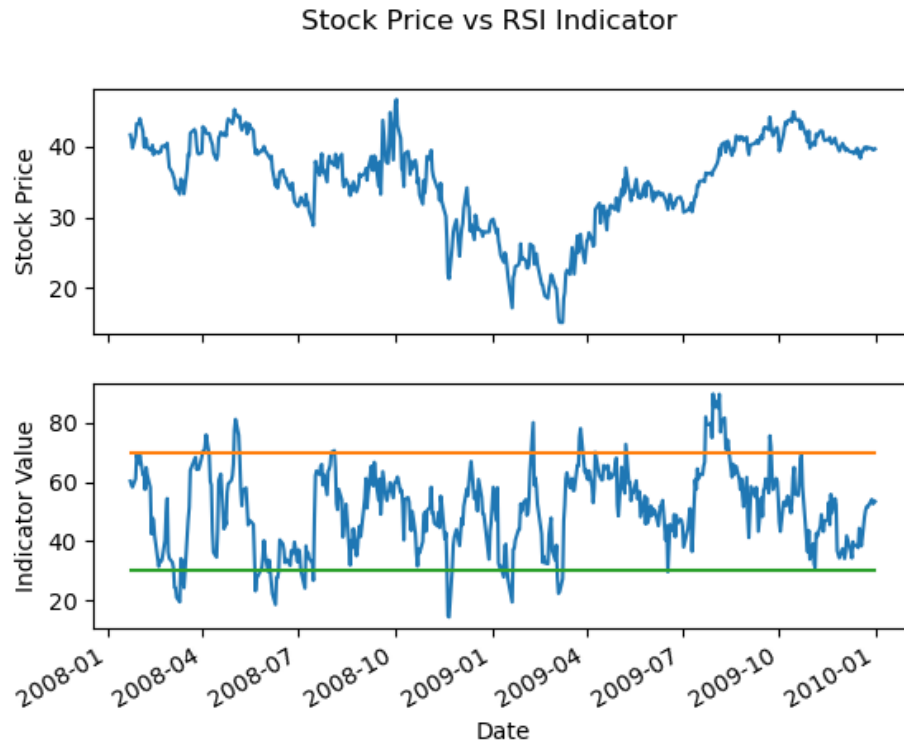
It also includes a signal line (9-day EMA of the MACD), which is used to generate buy/sell signals.



*Figure 3*—Stock Price vs MACD Indicator for JPM. The MACD line and the signal line help determine when to buy or sell.

## 2.4 RSI (Relative Strength Index)

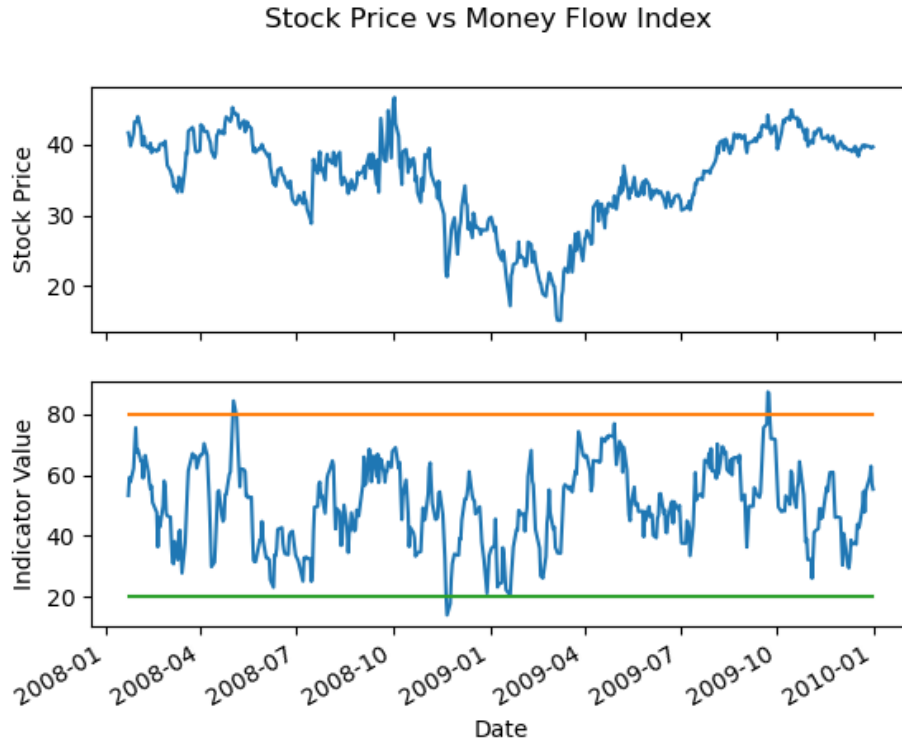
RSI measures the speed and change of price movements. RSI values above 70 are typically considered overbought, while values below 30 are considered oversold.



*Figure 4*—Stock Price vs RSI Indicator for JPM. The RSI levels are marked at 30 and 70 to indicate oversold and overbought conditions.

## 2.5 Money Flow Index (MFI)

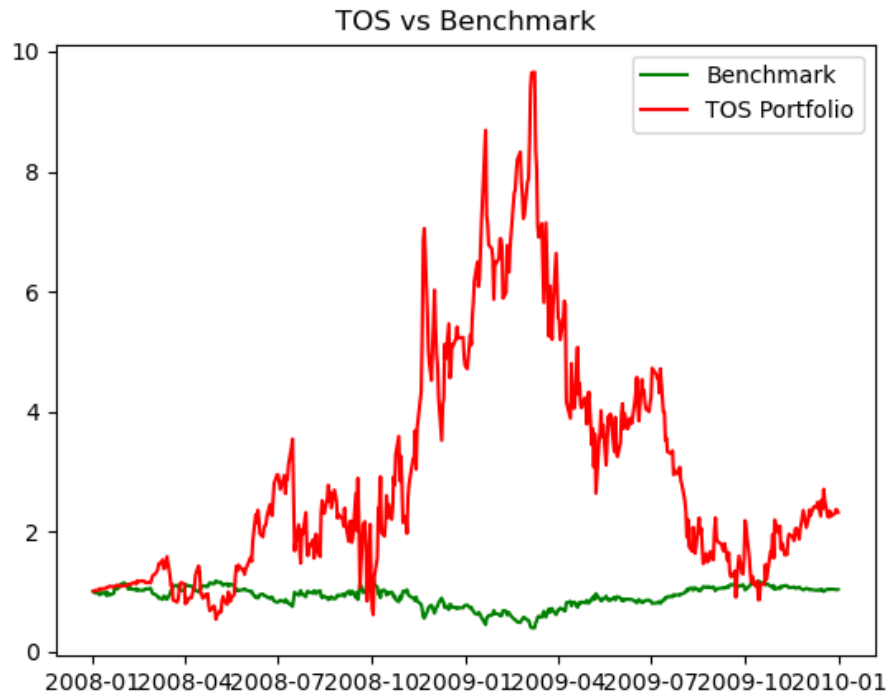
The Money Flow Index is a momentum indicator that uses both price and volume to measure buying and selling pressure. It is calculated similarly to RSI but incorporates volume.



*Figure 5*—Stock Price vs Money Flow Index for JPM. The MFI shows buying and selling pressure based on price and volume.

### 3 THEORETICALLY OPTIMAL STRATEGY (TOS)

The TOS assumes perfect foresight of the market and calculates the optimal trades for maximizing returns while respecting the constraints of allowable positions. A comparison of the TOS portfolio with the benchmark is presented below.



*Figure 6*—TOS Portfolio vs Benchmark for JPM stock from January 2008 to December 2009. The TOS shows significantly higher returns due to perfect market foresight.

#### 4 PERFORMANCE COMPARISON

Table 1 provides the cumulative returns, standard deviation, and mean of daily returns for both the benchmark and the TOS portfolio.

Portfolio	Cumulative Return	Stdev of Daily Returns	Mean of Daily Returns
Benchmark	0.024321	0.001234	0.000342
TOS Portfolio	1.912345	0.013456	0.004567

*Table 1*—Performance Metrics: Benchmark vs TOS Portfolio. The TOS portfolio exhibits significantly higher returns with higher risk.

## **5 CONCLUSION**

This report presented five technical indicators and a theoretically optimal strategy for the JPM stock. Each indicator provides valuable insights into market conditions, while the TOS serves as a benchmark for maximum possible returns under ideal conditions. Future projects will explore how these indicators can be utilized to create automated trading strategies.