Alpha-Engine: Quantitative Trading Strategy Back Testing Report

# Overview

This document summarises the back testing framework and key performance metrics of the implemented Simple Moving Average (SMA) Crossover Strategy applied to historical market data – namely, the stock price of Apple from 05/06/2020 to 05/06/2025. The goal is to provide a clear and transparent evaluation of the strategy’s effectiveness, risk, and realism by accounting for trading costs and measuring returns with robust financial metrics.

# Back Testing Methodology

- Data Source: Historical daily closing prices of the selected asset.  
- Strategy Logic: The SMA crossover uses two moving averages (fast and slow). A buy (long) signal is generated when the fast SMA crosses above the slow SMA; a sell (short) signal when it crosses below.  
- Positions: +1 for long, -1 for short, and 0 for neutral/no position.  
- Transaction Costs: Fixed cost of 0.1% per trade applied to simulate realistic trading conditions.  
- Performance Metrics: Evaluated with cumulative net strategy return, Sharpe ratio, max drawdown, and consideration of transaction costs.

# Performance Evaluation Metrics

## Applying Financial Mathematics

- Definition: The total compounded return of the strategy after subtracting transaction costs.  
The strategy in question is to use two simple moving averages – one with a fast lookback window (the past 20 days) and the other with a slow lookback window (the past 50 days).

A. The **Simple Moving Average** over days at time days:

where is the closing price on day

This strategy is very effective, as we consider the two different perspectives and compare the momentums. We also ensure that the trading position on day is not based on the signal generated on the same day. Rather, we base the trading position on an arbitrary day (on day ) off of the signal generated the day before (on day ). This helps us avoid lookahead bias which makes Alpha-Engine a more effective back testing engine!

B. Calculating market returns:

Use **.pct\_change()** to compute .

The strategy return is the product of the position on day and :

The *cumulative return of the market* can be calculated by the following formula:

## 1. Transaction Costs

Definition: Transaction costs represent fees and slippage incurred during buying and selling.  
Set the transaction cost to 0.1% - this is a common transaction cost.

Why is there a transaction cost?

When trading, buying and selling assets cost money due to fees arising from events like bid-ask spreads, commissions, slippage, etc.)

1.1 We wish to calculate how often our position changes during the event of a trade – obviously we will use **ae.[‘position’]** in our calculation however, because we do not need to concern ourselves with how our position changed, but instead if a trade occurred or not, then we can employ the absolute value function **abs()**.

1.2 The net strategy return is the strategy return after accounting for total trading costs and can be calculated by the following formula:

*This allows Alpha-Engine to avoid overfitting strategies that trade too much and gives the real-world cumulative performance, prioritising realistic results.*

## 2. Cumulative Net Strategy Return

The *cumulative net strategy return (CNSR)* can be calculated by the following formula:

- is the daily strategy return after transaction costs.  
- Interpretation: Represents the overall growth or loss of a $1 investment following the strategy over the back testing period.

*This gives the real-world cumulative performance of this strategy.*

## 3. Sharpe Ratio

Definition: Measures risk-adjusted return; how much excess return is earned per unit of risk.  
  
Additionally, we can use the **Sharpe ratio** which is a standard performance metric.

where is the number of trading days per annum (252).

How do we interpret the Sharpe Ratio?

A higher Sharpe ratio means that we get better returns **per unit of risk**.  
A positive Sharpe ratio indicates returns are achieved with some risk premium.   
A negative Sharpe ratio (as in this back test: **–0.35**) suggests the strategy underperforms the risk-free rate after adjusting for volatility, implying risk is not sufficiently compensated.

*This allows us to compare the cumulative performance of Alpha-Engine’s strategy with other back testing engines.*

## 4. Maximum Drawdown

- Definition: The largest peak-to-trough decline in the cumulative strategy returns during the back test.  
- Formula:  
  
Compute the rolling maximum (the highest value of the CNSR) at time .

Define the drawdown as a function of , such that

Note:

Compute the maximum drawdown by finding the most negative value of :

The observed maximum drawdown of **–69.41%** indicates a significant loss at the worst period during the back test. This represents a major risk to capital and suggests high volatility or poor timing in the strategy.

*This allows us to find the cumulative performance while considering capital preservation.*

# Summary of Results

|  |  |  |
| --- | --- | --- |
| Metric | Value | Comments |
| Transaction Cost Rate | 0.1% per trade | Realistic trading cost included |
| Cumulative Net Strategy Return | (varies) | Reflects net profitability after costs |
| Sharpe Ratio | -0.35 | Indicates underperformance on risk-adjusted basis |
| Maximum Drawdown | -69.41% | Large peak-to-trough loss, significant risk |

# Conclusion

While the SMA crossover strategy demonstrates the framework and mechanics of back testing with transaction costs and performance metrics, the current back test results highlight challenges:  
  
- The **negative Sharpe ratio** implies returns are not sufficient to compensate for volatility.  
- The **large maximum drawdown** suggests a risk profile that may not be acceptable for most investors.  
- These metrics underscore the importance of further strategy refinement, risk management techniques, and possibly combining multiple indicators or risk controls.