PARSHWANATH CHARITABLE TRUST'S
A.P. SHAH INSTITUTE OF TECHNOLOGY
Department of Computer Science and Engineering
Data Science
CSE DATA SCIENCE

Semester : VIII   Subject : AIFB   Academic Year : 2024-25

SIMPLE MOVING AVERAGE (SMA) CROSSOVER STRATEGY:

Here is a mathematical example of backtesting a Simple Moving Average (SMA) Crossover Strategy with a given stock price over a period of time.

Problem statement:

You have the following stock prices over 10 days :

Day	Stock price ($)
1	100
2	102
3	104
4	106
5	108
6	110
7	112
8	115
9	117
10	119

Now we backtest the SMA Crossover straategy with the following parameters :

Short - Term SMA :- 3-day SMA (for simplicity).

Long - Term SMA :- 5-day SMA

Buy Signal :- When the short term SMA crosses above the long-term SMA.

Sell Signal :- When the short term SMA crosses below the long -term SMA.

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Step 1: Calculate SMAs

3-Day SMA:

The 3-day SMA is calculated by averaging the last 3 days closing prices.

Day	Stock Price ($)	3-Day SMA.
1.	100	—
2.	102	
3.	104	$(100+102+104)/3 = 102$
4.	106	$(102+104+106/3 = 104$
5.	108	$(104+106+108)/3 = 106$
6.	110	$(106+108+110)/3 = 108$
7.	112	$(108+110+112)/3 = 110$
8.	115	$(110+112+115)/3 = 112.3$
9.	117	$(112+115+117/3 = 114.67$
10.	119	$(115+117+119)/3 = 117$.

5-Day SMA: The 5 day SMA is calculated by averaging the last 5 days closing prices.

Day	Stock Price ($)	5-Day SMA.
1.	100	—
2.	102	—
3.	104	—
4.	106	—
5.	108	$(100+102+104+106+108)/5 = 104$
6.	110	$(102+104+106+108+110)/5 = 106$
7.	112	$(104+106+108+110+112)/5 = 108$
8.	115	$(106+108+110+112+115)/5 = 110.2$
9.	117	$(108+110+112+115+117)/5 = 112.4$.
10.	119	$(110+112+115+117+119)/5 = 114.6$

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Step 2: Generate Buy/Sell signals:

→ On day 8, the 3-day SMA (112.33) crosses above the 5-day SMA (110.2) → Buy signal.

→ On day 9, the 3-day SMA (114.67) is higher than the 5-day SMA (112.4) → Buy signal.

→ On day 10, the 3-day SMA (117) continues to stay above the 5-day SMA (114.6), still buy signal, so no action needed.

Step 3: Calculate Portfolio value:

Let's consider an initial investment of $10,000 and that you are buying the stock with your entire capital when the buy signal occurs.

At buy signal at Day 8:

Stock price on day 8 = $115.

shares bought = 87 shares. ————→ ($10,000/$115)

At buy signal at Day 9.

Stock price on day 9 = $117.

Additional Shares bought = ($10,000/$117) = 85 shares.

Final portfolio Value (Day 10):

On day 10, the stock price is $119.

Total shares owned = 87 + 85 = 172 shares.

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Portfolio value = ~~188~~ 172 * $119 $\boxed{= \$20,468}$

Step 4: Performance metric

(1). Total return :

$$\text{Total return} = \frac{\text{Final Portfolio Value} - \text{Initial Capital}}{\text{Initial Capital}}$$

$$= \frac{(\$20,468 - \$10,000)}{\$10,000} = 1.0468$$

$$\boxed{\text{Total return \% } = 104.68\%}$$

(2) Annualize period (CAGR) :

To calculate CAGR, consider the backtest period is 10 days, and the inital capital is $10,000.

$$CAGR = \left(\frac{\text{Final portfolio value}}{\text{Initial Capital}}\right)^{1/n} - 1$$

$$\text{For 10 days,} \atop CAGR \Big\} = \left(\frac{20,468}{10,000}\right)^{(10/365)} - 1.$$

$$= \left(\frac{20,468}{10,000}\right)^{1/0.27} - 1$$

Buy signal occured on Day 8 and 9. Portfolio value grew from $10,000 to $20,468 by day 10. Total return was 104.68% over the 10-day period. This example illustrates how a simple SMA Crossover strategy can be backtested mathematically to evaluate performance based on specific buy/sell signal & portfolio value tracking.

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