

SMA, Tenkan-sen and Kijun-sen

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1 Model Theory

Uses 4 period simple moving average ($A(4, t)$), Tenkan-sen ($T(t)$) and Kijun-sen ($K(t)$) indicators from the Ichimoku Kinkohyo indicator set.

Simple moving average equation;

$$A(x, t) = \frac{\left(\sum_{n=t-x+1}^t p(n) \right)}{x} \quad (1)$$

where x is the number of periods included in the average and $p(t)$ is the price at time t (the close price will be used in this model).

Tenkan-sen equation [1];

$$T(t) = \frac{\max(p(t')|_{t'=t-8}^{t'=t}) + \min(p(t')|_{t'=t-8}^{t'=t})}{2} \quad (2)$$

Qualitatively, the average of the minimum and maximum close prices over the past 9 periods including the current one.

Kijun-sen equation [1];

$$K(t) = \frac{\max(p(t')|_{t'=t-25}^{t'=t}) + \min(p(t')|_{t'=t-25}^{t'=t})}{2} \quad (3)$$

Qualitatively, the average of the minimum and maximum close prices over the past 26 periods including the current one.

Certain crossings of these indicators described in the algorithm section will then give the conditions for the open and close of orders.

This model is tested on the 1 minute EUR/USD symbol.

2 Order Algorithm

2.1 Buy orders

Buy open conditions;

1. Initial condition: $A(4, t_0) < T(t_0) < K(t_0)$
2. Condition 1: $T(t_1) < A(4, t_1) < K(t_1)$
3. Condition 2: $T(t_2) < K(t_2) < A(4, t_2)$
4. Condition 3: $K(t_3) < T(t_3) < A(4, t_3)$

These must occur in order to produce a buy open signal, $(t_0 < t_1 < t_2 < t_3)$.
Buy close conditions;

1. Initial conditions: $K(t_0) < T(t_0)$
2. Condition 1: $K(t_1) > T(t_1)$

This will close the buy order, $(t_0 < t_1)$.

2.2 Sell orders

Sell open conditions;

1. Initial condition: $A(4, t_0) > T(t_0) > K(t_0)$
2. Condition 1: $T(t_1) > A(4, t_1) > K(t_1)$
3. Condition 2: $T(t_2) > K(t_2) > A(4, t_2)$
4. Condition 3: $K(t_3) > T(t_3) > A(4, t_3)$

These must occur in order to produce a sell open signal, $(t_0 < t_1 < t_2 < t_3)$.
Sell close conditions;

1. Initial conditions: $K(t_0) > T(t_0)$
2. Condition 1: $K(t_1) < T(t_1)$

3 Code structure

Elements to be built into the code to achieve the functionality described in the previous two sections.

1. Data source (<https://www.histdata.com/>).
2. Data extraction and reading into close price array.
3. Functions to calculate the 4 SMA, Tenkan-sen and Kijun-sen for each close price.
4. for loop to run through order algorithms in order to recognise entry and exits points. Profit/Loss calculations for each trade for cumulative profit/loss over time for graphing. Outputs written to a file for analysis.

4 Results

The lower the SMA period used the larger the magnitude of the profit/loss. After testing for the whole year of 2020 the system ends in a loss for a 2 period SMA if the current rules are used so I just reversed the orders so that the buy conditions give a sell and visa versa. This method ended up in profit. See figure 1 for the 2 period SMA profit and loss over trades, figure 2 for the reversed conditons as described and figure 3 for the reversed conditons using a 4 period SMA.

5 Future work

Next will be running this model against different exchange rate pairs.

Also look into only using the strategy at certain times of day, maybe when larger trends are occuring like the crossover of the London and New York sessions.

6 Notes and ideas

Could replace the exit signal with open durations (fixed or somehow variable) instead of the current suggestion the crossing of the Tenkan-sen and Kijun-sen.

Test for different forex pairs and maybe stocks or derivatives such as EFTs.

Will have to reformulate the code into a real time API system either in C++ or Python if successfull in backtesting.

Take note that the code does not currently take into account fees or spread.

References

- [1] Shangkun Deng and Akito Sakurai. Short-term foreign exchange rate trading based on the support/resistance level of ichimoku kinkohyo. In *2014 International Conference on Information Science, Electronics and Electrical Engineering*, volume 1, pages 337–340, 2014.

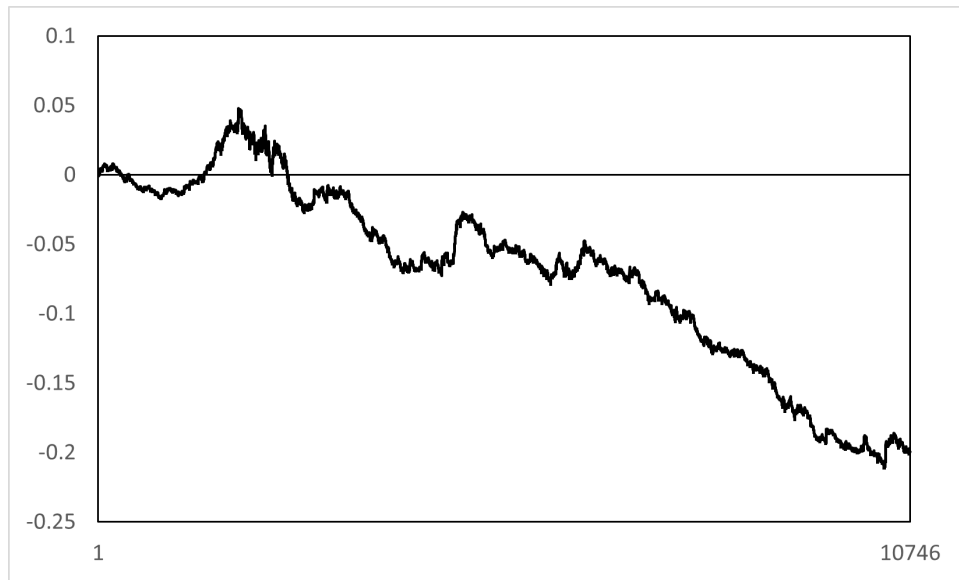


Figure 1: 2 period SMA cumulative profit and loss over trades with conditions listed above.

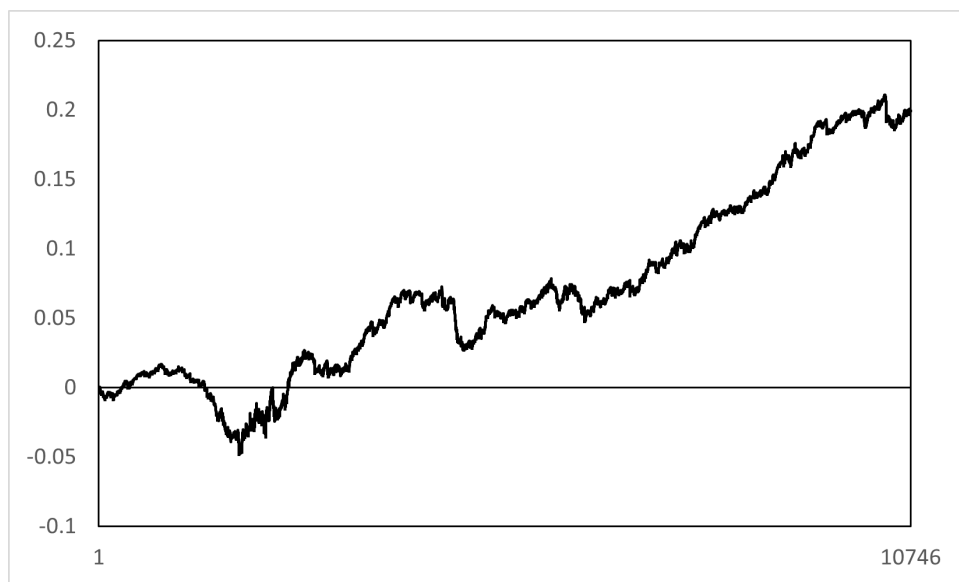


Figure 2: 2 period SMA cumulative profit and loss over trades with the reverse of conditions listed above.

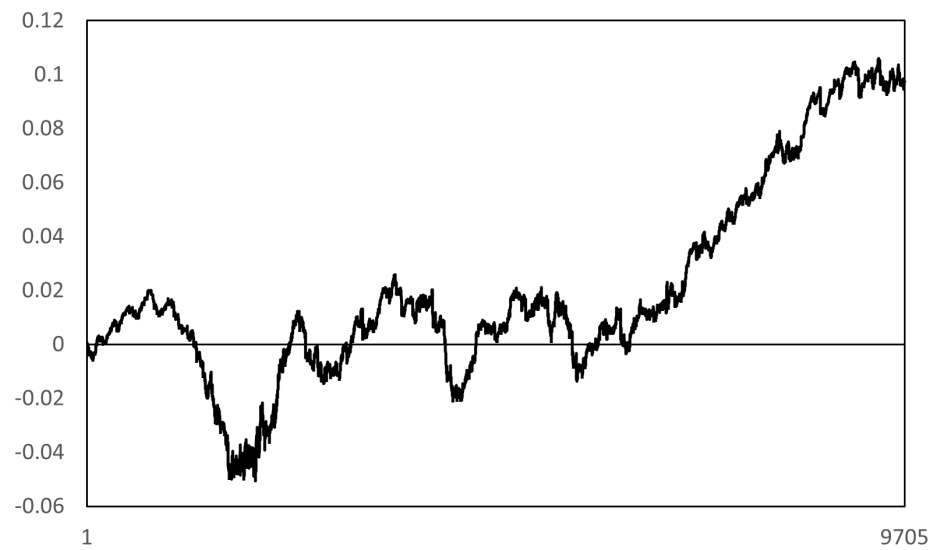


Figure 3: 4 period SMA cumulative profit and loss over trades with the reverse of conditions listed above.