

# Technical Indicator: Moving Average

## 技術指標：均線

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# 均線( Moving Average, MA )

## ○ 均線( MA )定義

- 一段時間內的平均價格，代表此時間內買入股票的平均成本
- 是一項最基礎且最普及的技術指標

## ○ 範例

- 5日均線（5MA、週線）
  - 最近 5 個交易日的平均收盤價
- 20日均線（20MA、月線）
  - 最近 20 個交易日的平均收盤價

## ○ 計算方式

- 將前 $n$ 天（含今天）的收盤價加總後除以 $n$ ，得到今天的 $n$ MA

## 均線：計算範例

Quiz!

○ 股價：6, 3, 7, 8, 5, 1, 2, 4, 9, 6

• 算法一

○ 3MA = 6.00, 4.50, 5.33, 6.00, 6.67, 4.67, 2.67, 2.33, 5.00, 6.33

○ 4MA = 6.00, 4.50, 5.33, 6.00, 5.75, 5.25, 4.00, 3.00, 4.00, 5.25

• 算法二

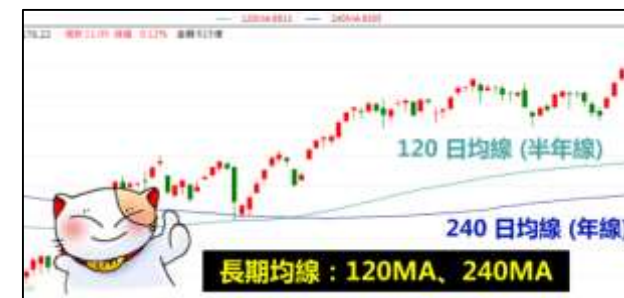
○ 3MA = nan, nan, 5.33, 6.00, 6.67, 4.67, 2.67, 2.33, 5.00, 6.33

○ 4MA = nan, nan, nan, 6.00, 5.75, 5.25, 4.00, 3.00, 4.00, 5.25

nan = not a number

# 短期、中期、長期均線

- 短期均線（簡稱「短線」）
  - 5 日均線(週線)、10 日均線(雙週線)
  - 適用於短線操作的投資人
- 中期均線（簡稱「中線」）
  - 20 日均線(月線)、60 日均線(季線)
  - 適用於中線操作的投資人
- 長期均線（簡稱「長線」）
  - 120 日均線(半年線)、240 日均線(年線)
  - 適用於長線操作的投資人



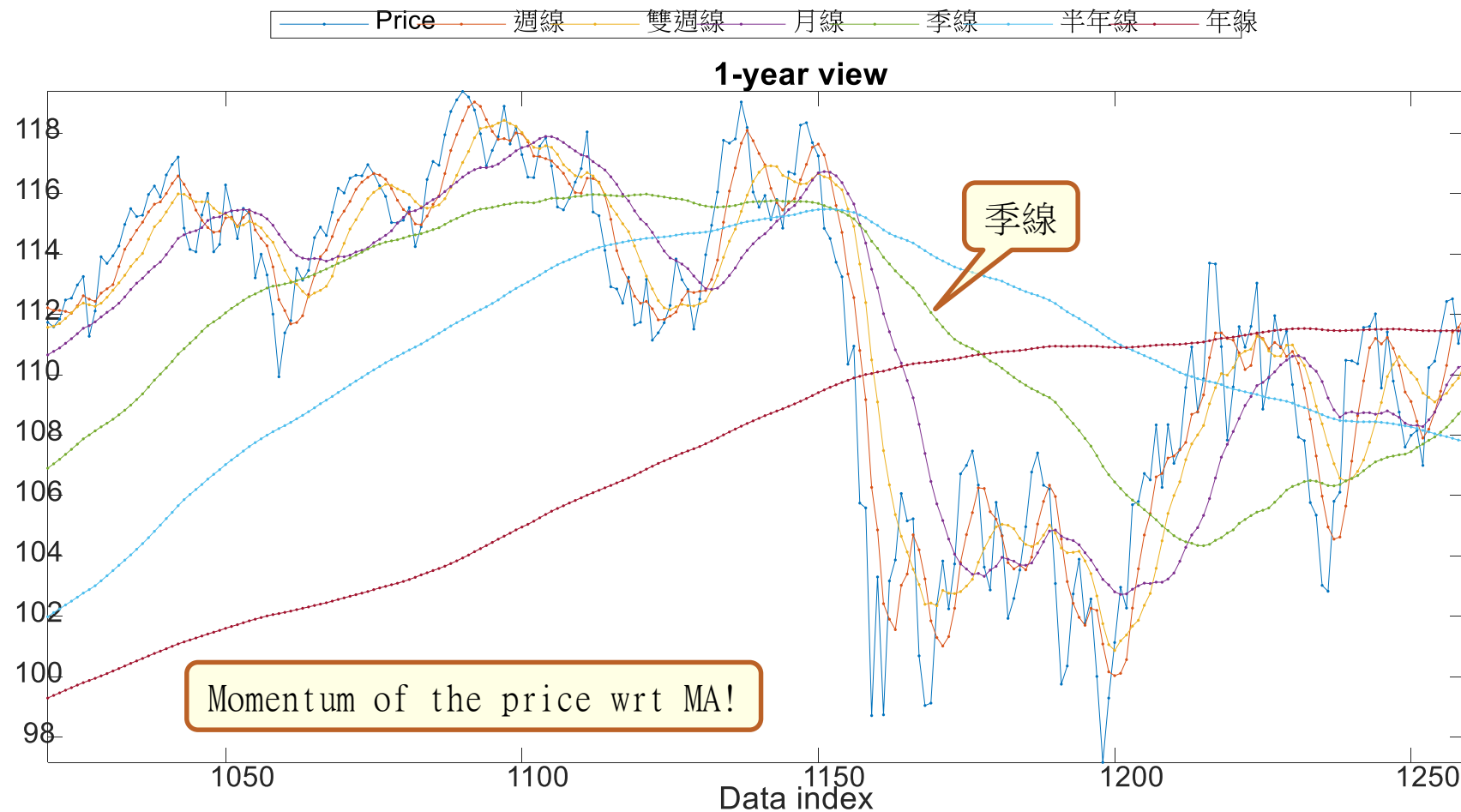
# Example of MA: 10-year View of SPY500

○ 2007/01/03 ~ 2017/10/25



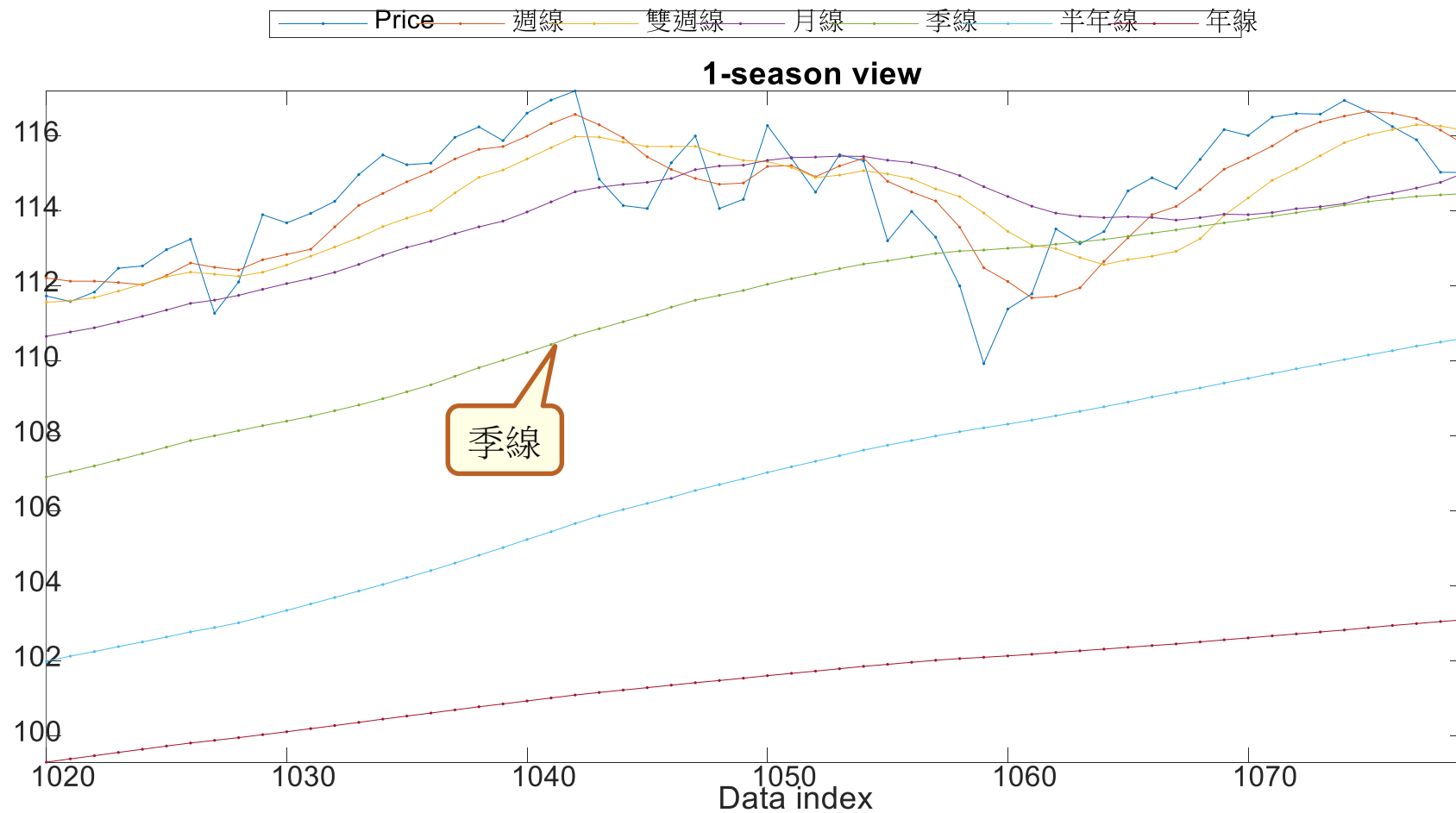
# Example of MA: 1-year View of SPY500

○ 2011/01/19 ~ 2011/12/28



# Example of MA – 1-quarter View of SPY500

○ 2011/01/19 ~ 2011/04/12



# Trading Strategy based on MA

- Basic (and poor) trading strategy based on MA

- Buy if the price is larger than MA
- Sell if the price is lower than MA

- Backtest (回測)

- Verify how the strategy performs
- Optimize the parameters of strategy
  - Find the best value of  $n$  (window size)
- Assume
  - Buy and sell at the price of “adj close”.
  - Buy with all your money, sell with all your holdings. (All-in and all-out.)
  - Require no transaction fee

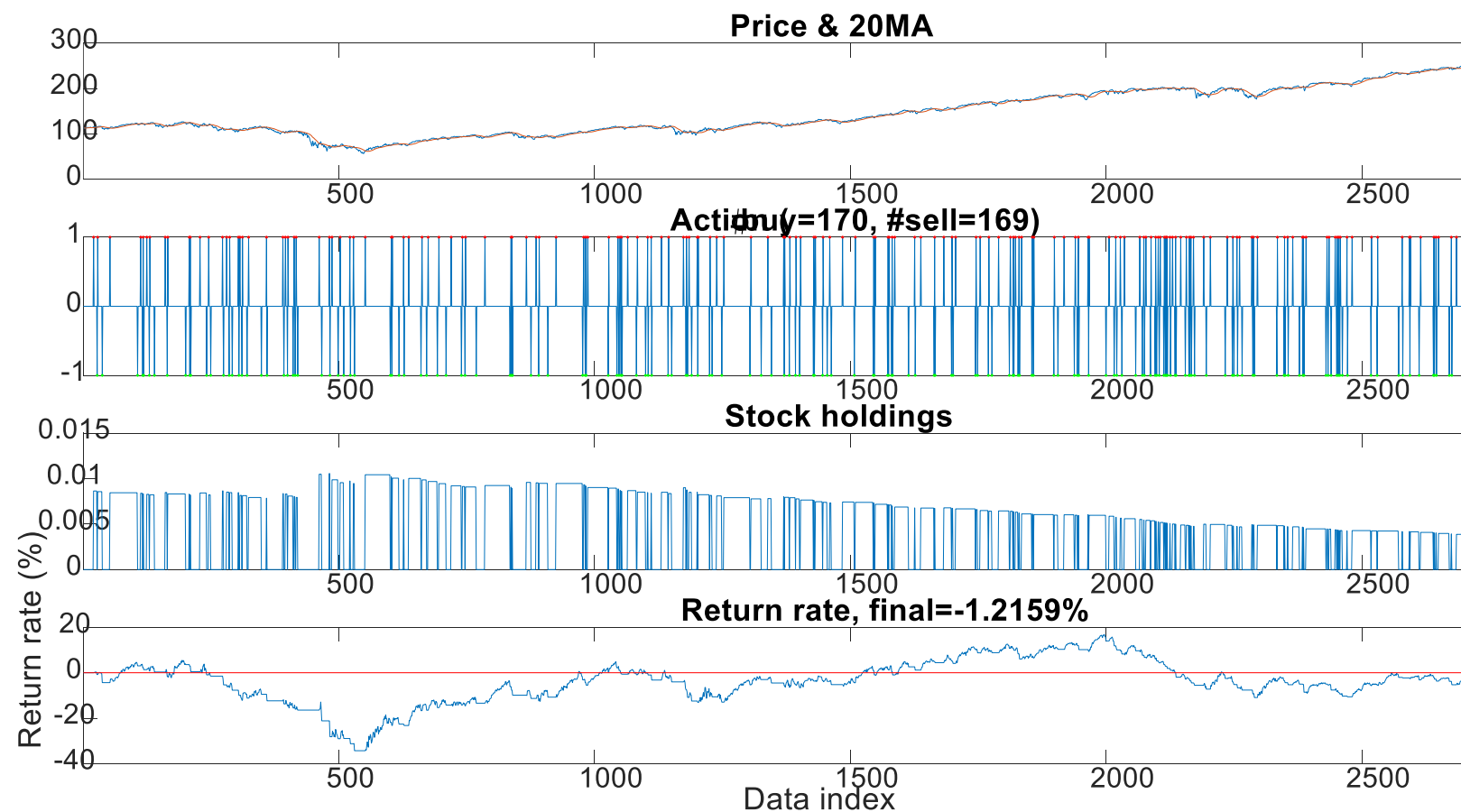
Emergence of ML!



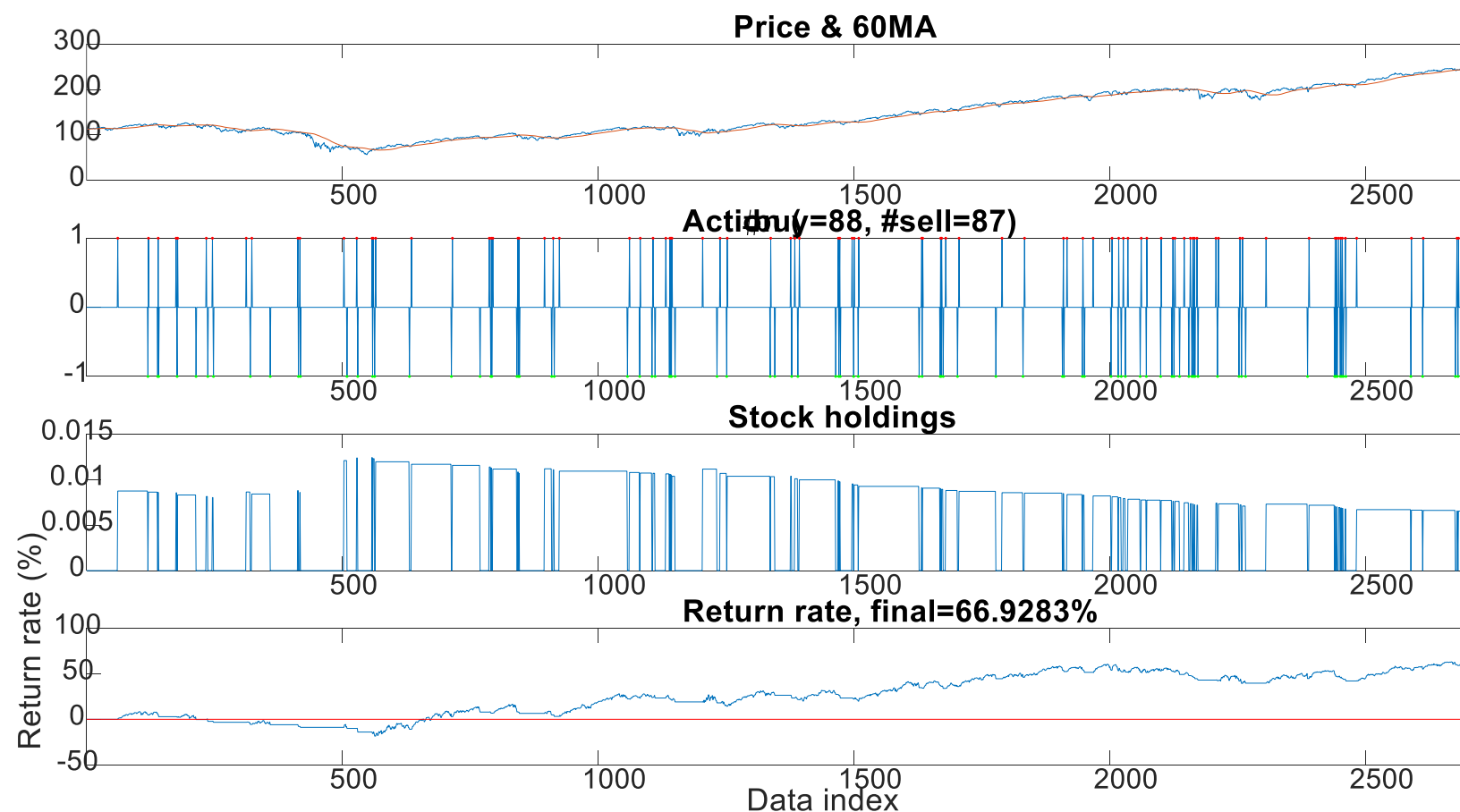
## Profit Estimate via 5MA (週線)



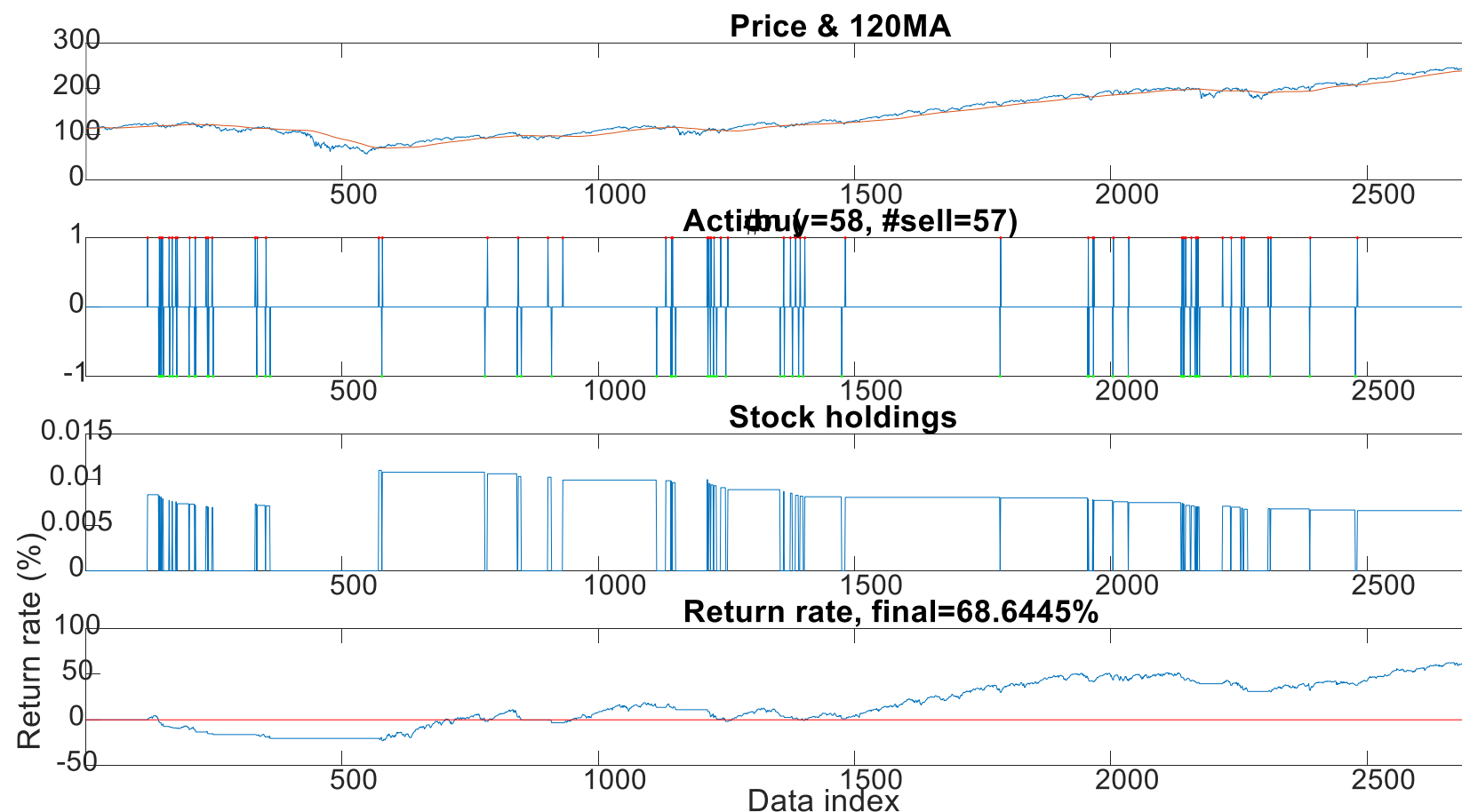
# Profit Estimate via 20MA (月線)



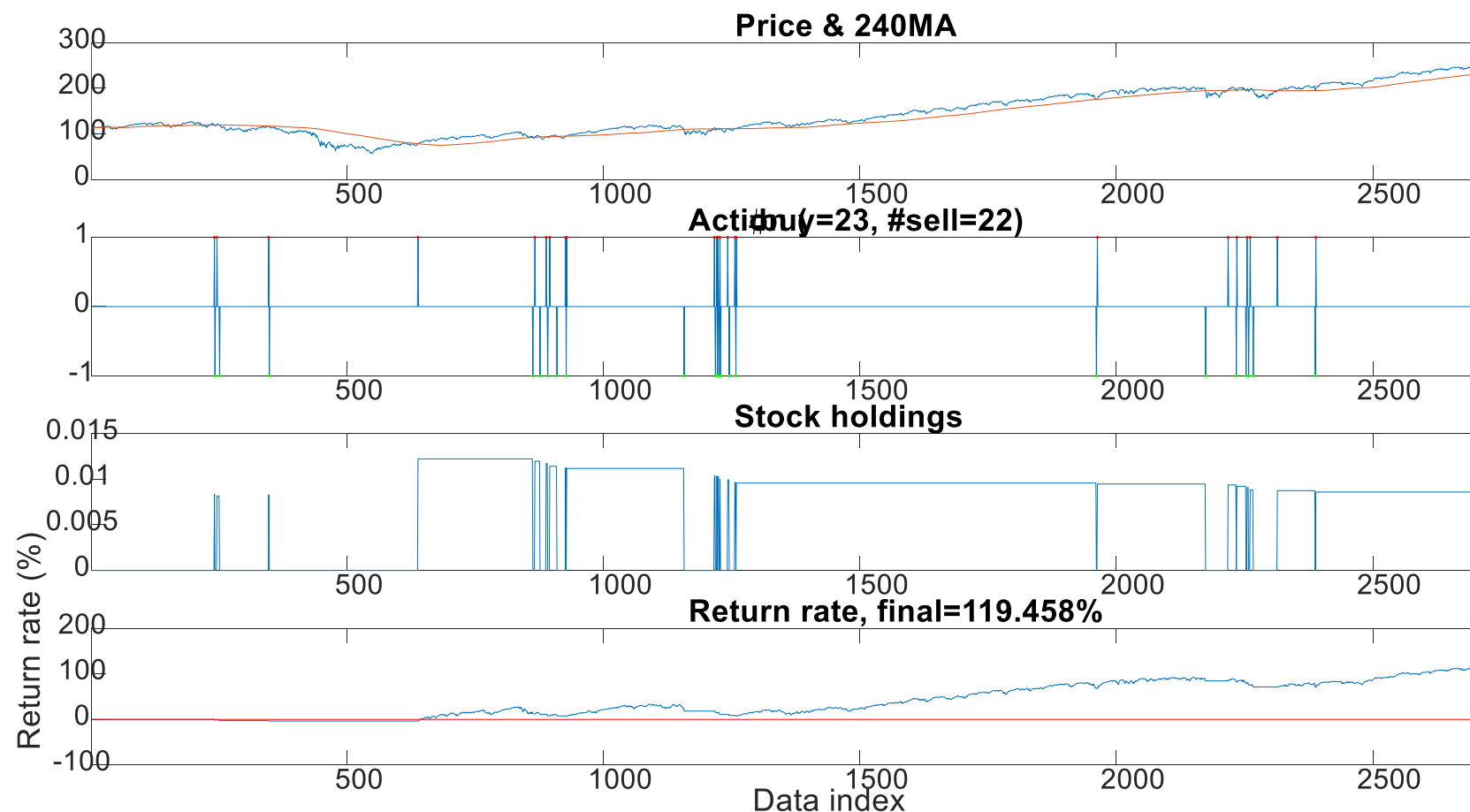
# Profit Estimate via 60MA (季線)



# Profit Estimate via 120MA (半年線)



# Profit Estimate via 240MA (年線)



# MA Profit vs. Windows



## Extension of MA-based strategy

- Adopt variants of MA
  - SMA (simple MA)、WMA (weighted MA)、EMA (exponential MA) ([wiki](#))
- 買點與賣點
  - 黃金交叉：短期均線大於長期均線 → 買進
    - For example,  $5MA > 20MA$
  - 死亡交叉：短期均線小於長期均線 → 賣出
    - For example,  $5MA < 20MA$
- Another possibility
  - Buy when the current price is higher than MA by a margin  $\alpha$
  - Sell when the current price is lower than MA by a margin  $\beta$

## More about Moving Average (1/3)

- General formula of MA

$$\mu_i = \frac{w_i s_i + w_{i-1} s_{i-1} + w_{i-2} s_{i-2} + \cdots + w_{i-n+1} s_{i-n+1}}{w_i + w_{i-1} + w_{i-2} + \cdots + w_{i-n+1}} = \frac{\sum_{k=1}^n w_{i-k+1} s_{i-k+1}}{\sum_{k=1}^n w_{i-k+1}}$$

- SMA (simple MA)

- General formula

$$\mu_i = \frac{\sum_{k=1}^n s_{i-k+1}}{n}$$

- Example when n=5

$$\mu_i = \frac{s_i + s_{i-1} + s_{i-2} + s_{i-3} + s_{i-4}}{5}$$



## More about Moving Average (2/3)

- WMA (weighted MA)

- General formula:

$$\mu_i = \frac{\sum_{k=1}^n \frac{n-k+1}{n} s_{i-k+1}}{\sum_{k=1}^n \frac{n-k+1}{n}}$$

- Example when n=5:

$$\mu_i = \frac{\frac{5}{5} s_i + \frac{4}{5} s_{i-1} + \frac{3}{5} s_{i-2} + \frac{2}{5} s_{i-3} + \frac{1}{5} s_{i-4}}{\frac{5}{5} + \frac{4}{5} + \frac{3}{5} + \frac{2}{5} + \frac{1}{5}}$$

## More about Moving Average (3/3)

### EMA

General formula:

$$\mu_i = \frac{s_i + r s_{i-1} + r^2 s_{i-2} + \dots + r^{i-1} s_1}{1 + r + r^2 + \dots + r^{i-1}} = \frac{\sum_{k=0}^{i-1} r^k s_{i-k}}{\sum_{k=0}^{i-1} r^k} = \frac{\sum_{k=0}^{i-1} r^k s_{i-k}}{\frac{1-r^i}{1-r}}.$$

Since  $i \gg 1$  and  $0 < r < 1$ , we have

$$\mu_i = (1 - r) \sum_{k=0}^{i-1} r^k s_{i-k}$$

Or equivalent iterative formula:

$$\begin{cases} \mu_{i+1} = r\mu_i + (1 - r)s_{i+1}, i = 2, 3, \dots, n \\ \mu_1 = s_1. \end{cases}$$

Usually  $r = (n-1)/(n+1)$ , where  $n$  is equivalent to a window size.

# MA References

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- 均線
  - 什麼是均線？
  - 股票投資人，你知道什麼是均線嗎？
    - 突破均線糾結 強勢股
    - 阿斯匹靈判斷盤勢多空理財寶(很多用到均線觀念)
  - 什麼是「均線糾結」？
  - 移動平均 (Wiki)
- 回測
  - 回測容易犯的幾種錯誤