Understanding moving averages strategies with the help of toy models using R

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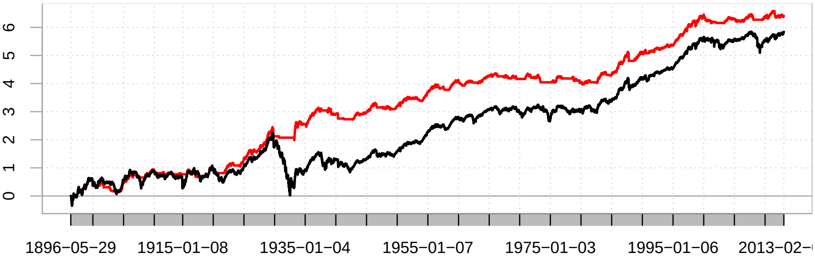


Goal and Contribution

- Understand mathematically Moving Average strategies: alternative way of looking at old results.
- First step towards a mathematical framework to describe trading strategies.
- Toy model?
  - Model that is not optimized for trading but which main purpose is to be a proxy for MA models.
  - Performance is solved in close form yielding intuitive formulas
- Main Results
  - Good agreement with data
  - In a stationary world MA is generally not optimal (largest Sharpe)
  - In a non-stationary reality, the main goal of MA is to be an estimation of the local asset drift (trend)

Our toy model/strategy

$$\begin{cases} x_i = \ln(S_i/S_{i-1}), S_i = Price\ in\ period\ "i" \\ m_n(N) = \sum_{i=n-N+1}^{n} x_i/N \\ m_n(N) > 0 \rightarrow Buy\ \ m_n(N)\ Shares \\ m_n(N) < 0 \rightarrow Short\ \ m_n(N)\ Shares \end{cases} \tag{1}$$

- Use log-returns as input time series
- Introduce ranking naturally by giving more weight to top m values
- Simple, not optimized and "easy" to formulate mathematically:

$$\langle R \rangle = \frac{1}{N} \sum_{i=1}^{N} \langle X_t X_{t-i} \rangle = \mu^2 + \frac{V}{N} \sum_{i=1}^{N} \rho(t, t-i) \tag{2}$$

Stationary process - When does it work?

In case of stationary process of the form:

$$X_t = \mu + \epsilon_t + \sum_{i=1}^{q} \theta_i \epsilon_{t-i} + \sum_{i=1}^{p} \varphi_i X_{t-i} \tag{3}$$

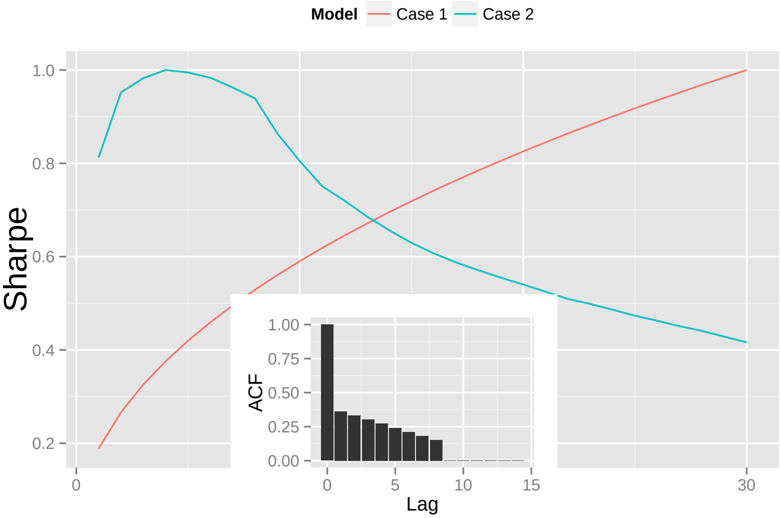
Case 1: $\rho(t, t-i) = 0$, Sharpe ratio is

$$Sh = \frac{\mu^2}{\sqrt{V\mu^2 + \frac{V^2}{N} + \frac{\mu^2 V}{N}}} \xrightarrow[N\to\infty]{take} \frac{|\mu|}{\sqrt{V}} \tag{4}$$

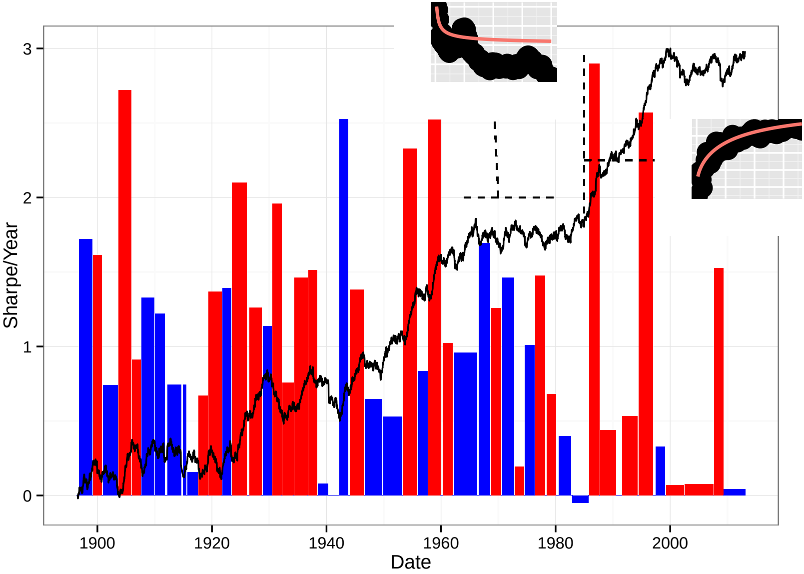
Case 2: $\mu = 0$, Sharpe ratio is

$$Sh = \frac{\sum_{i=1}^{N} \rho(t, t-i)}{\sqrt{N + (\sum_{i=1}^{N} \rho(t, t-i))^2 + (\sum_{i,j=1, i\neq j}^{N} \rho(t-j, t-i))}} \tag{5}$$

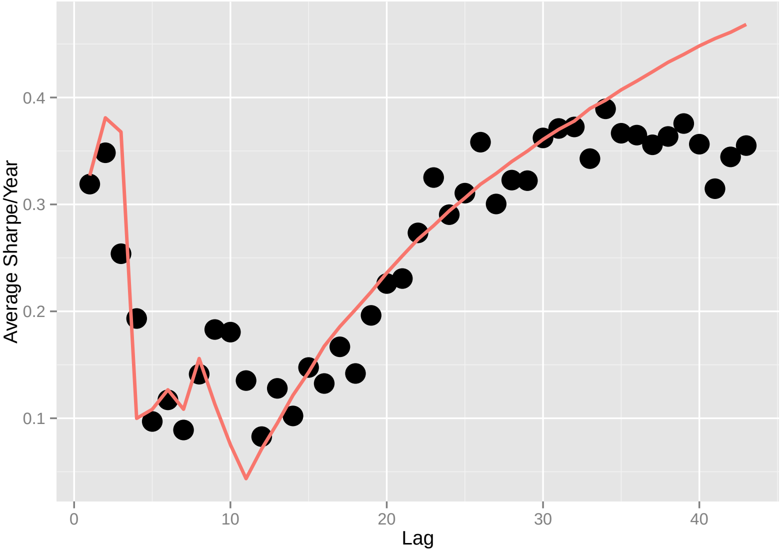
Stationary process - When does it work?



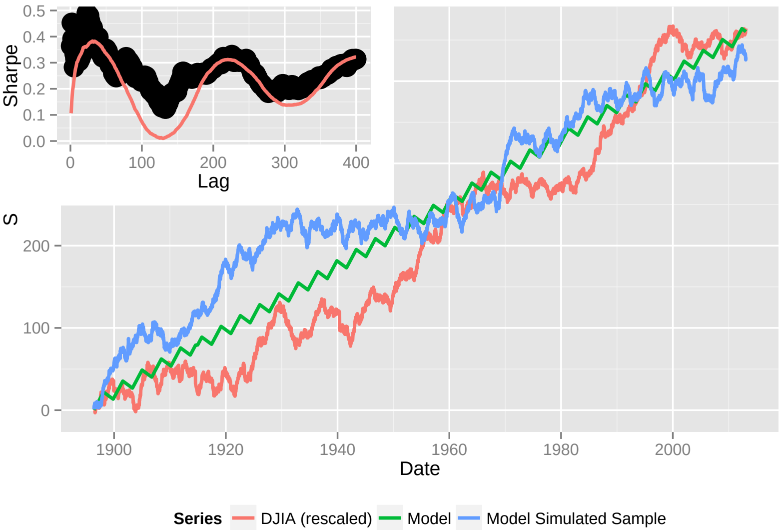
Looking at Data - DJIA



Average spectrum over all stationary regimes



Nonstationary (full sample)



More information and sample code

- http://rpubs.com/silvaac/6165