Stock Trading Strategy Backtesting

Define a stock price time series as a function with a date parameter T that returns daily stock prices $x_t \in \mathbb{R}^+$ for all days up until T.

$$x_t := t \to \mathbb{R}^+$$

for M descrete dates $t = (t_0, t_1, \ldots, t_i, .., t_M = T)$ where T is most recent/current date.

Define lag operator (function) L and parameter τ

$$L^\tau(x_t) = L^\tau x_t = x_{t-\tau}$$

Define trailing summation operator (function) S and parameter τ

$$S^\tau(L(x_t)) = S^\tau(L)x_t = \sum_{i=0}^{\tau} L^i x_t = x_{t-\tau}$$

The $\tau-$day simple moving average

$$\text{sma}^\tau(x_t) = \frac{S^\tau(L)x_t}{\tau} \in \mathbb{R}^+$$

In general, an indicator is a f is a (parameterized) function that takes a time series and a returns a single number

$$f := x_t \to \mathbb{R}^+$$

Indicator Comparison Strategy

Specifiy 2 indicators f and g and input time series x_t and define binary recommender that returns: BUY or SELL.

$$r(x_t, f, g) = \begin{cases} \text{if: } f(x_t) < g(x_t) \text{ then BUY} \\ \text{else: SELL} \end{cases}$$

Naive Binary Bot

`initial input:` - binary recommender $r(\cdot, f, g)$ - set of all available assets $A = \{a_j\}$ and associated set of time series $X_t = \{x_{j,t} : a_j \in A\}$ - time interval $t = (t_a, t_b)$ - go to input

`input:` - point in time $t \in (t_a, t_b)$ - A universe of stocks - previous day's portfolio of N holdings $P_{t-1} = (a_k, w_k)_{k=0}^{N-1}$ -