Moving Average (MA)

Create a series of averages of different subsets of the full data set.

- Capture average changes
- Smooth out the short-term fluctuations and highlight long-term trends/cycles

Applications:

- Understand the price movement patterns of the underlying
- Detect a change in momentum for a security.

Calculations

1. Simple Moving Average(SMA): take arithmetic mean of a given set of data over the specific number of days in the past

   for example, over the previous 15, 20, 100, or 200 days

2. Cumulative moving average:

$$CMA_n = \frac{x_1 + x_2 + \cdots + x_n}{n}$$

$$CMA_{n+1} = \frac{x_{n+1} + n \cdot CMA_n}{n+1}$$

3. Weighted moving average: an average that give different weights to data at different time.

$$\text{WMA}_M = \frac{np_M + (n-1)p_{M-1} + \cdots + 2p_{((M-n)+2)} + p_{((M-n)+1)}}{n + (n-1) + \cdots + 2 + 1}$$

4. Exponential moving average: apply weighting factors which decrease exponentially

$$\text{EMA}_{\text{today}} = \alpha \left[p_1 + (1-\alpha)p_2 + (1-\alpha)^2 p_3 + (1-\alpha)^3 p_4 + \cdots\right]$$

where

- p_1 is $\text{price}_{\text{today}}$
- p_2 is $\text{price}_{\text{yesterday}}$
- and so on

$$\text{EMA}_{\text{today}} = \frac{p_1 + (1-\alpha)p_2 + (1-\alpha)^2 p_3 + (1-\alpha)^3 p_4 + \cdots}{1 + (1-\alpha) + (1-\alpha)^2 + (1-\alpha)^3 + \cdots},$$

since $1/\alpha = 1 + (1-\alpha) + (1-\alpha)^2 + \cdots$.

α: the degree of weighting decrease

- a constant smoothing factor between 0 and 1
- a higher α discount older data point faster
- no “accepted” value for α; a common used value for α: $\frac{2}{N+1}$