**Smoothing (Moving averages)**

Smoothing (moving averages) is one of many methods used to filter noise (remove random variation) out of a data set. The moving average is a method which compute a series of averages covering up all the data points. The series of averages are basically several averages that has been calculated based on each data point while taking into consideration either the next data points or the previous data points. Furthermore, the moving averages is also called a moving mean (MM) or rolling mean. Smoothing is usually used to smooth out short-term fluctuation while emphasize the long-term trends [1].

Smoothing with moving averages can be characterized into two main groups [2]:

1. Averaging methods
   1. Simple moving average

* This is done by taking the mean of a certain amount of data from both side of that data point. Taking mean by involving both side of that data point make sure that the variation in the mean are synchronized with the variation in the data rather than being shifted [1].
* The range of “n” which is the number of data points to be considered for the mean depends strongly on the kind of movement of interest whether if it was short, intermediate, or long term.
* One of the disadvantages of the SMA is that it might not be effective enough to remove noises if the range of “n” was not big enough or if there was a sudden unexpected noise in the data for a period larger or equal to the length of range “n”. Hence, one can see some peak points in the smoothed result.
* Unweighted mean “n”
  1. Cumulative moving average
     + This is done by taking the mean of all available data points. This method works with datum stream as it keep taking into consideration the new data points by recomputing the mean of all the available data points while considering the new data points.
     + Weighted mean “n”
     + https://towardsdatascience.com/moving-averages-in-python-16170e20f6c#:~:text=The%20Cumulative%20Moving%20Average%20is,computing%20the%20cumulative%20moving%20average.
  2. Weighted moving average
     + This can be done by summing up the multiplication of the previous data points by a certain weight in which the sum of all weight is equal to 1 [3].
     + This can also be done by multiplying the previous data point by a certain weight and then dividing the results by the total weight. The total weight here can be any suitable value [3].
     + To check which algorithm has a better result, one can check the mean absolute deviation (MAD) of the error of each algorithm at a certain point [3].
     + This method is usually used when there is the need to place more importance on some period over the other periods [3].

1. Exponential smoothing methods [7]

References:

1. <https://en.wikipedia.org/wiki/Moving_average#Other_weightings>
2. <https://www.itl.nist.gov/div898/handbook/pmc/section4/pmc42.htm>
3. <https://www.youtube.com/watch?v=DipOB2H6ick>
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6. <https://www.datacamp.com/community/tutorials/moving-averages-in-pandas>
7. <https://en.wikipedia.org/wiki/Exponential_smoothing>