Measures of Fluctuations

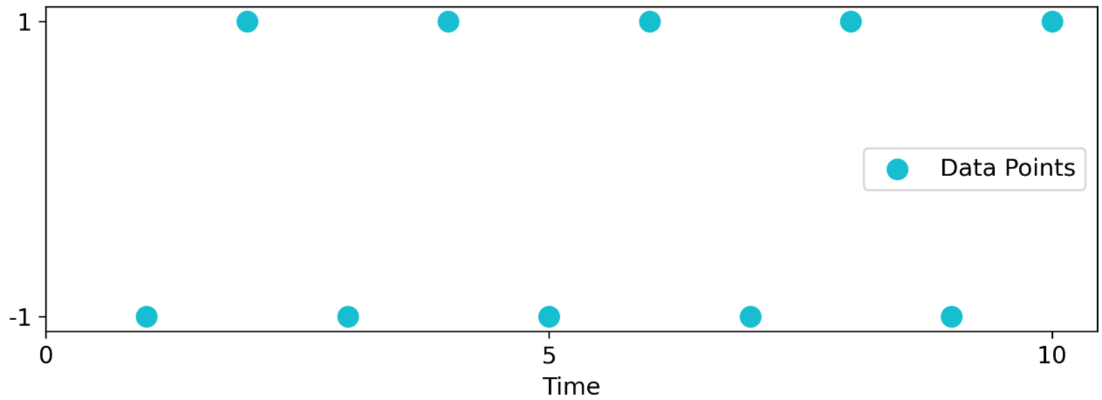
Introduction

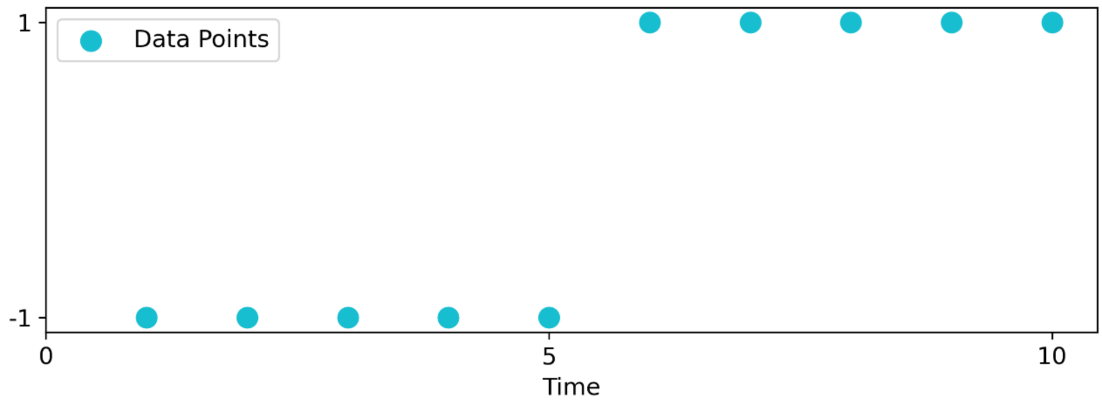
In statistics, understanding the variability or fluctuations within a dataset is crucial for gaining insights into the underlying processes. While measures like variance provide valuable information about the spread of data points, they often overlook the sequential nature of the data. In this blog, we delve into the concept of measuring fluctuations and why it is essential for a comprehensive analysis.

Why measure of fluctuations it is needed?

Traditional measures of variability, such as variance, serve as fundamental tools for quantifying the dispersion of data points. However, they fail to capture the temporal dependencies or patterns present in sequential data. Fluctuations, on the other hand, offer a more subtle understanding by considering the sequential arrangement of data points. It is imperative to distinguish between variance and fluctuations, as they represent distinct aspects of data variability.

For instance, consider the following datasets with identical variance. Despite their equal variance, their visual representations reveal differing levels of fluctuation.





Defining Measure of Fluctuations

Fluctuations can be conceptualized as the variability observed within contiguous subsequences of data points over time. To formalize this concept, let's define $Fluctuation(Values, Lag, Stride)$ as the average of the variances of all contiguous subsequences of length "Lag" with a step size of "$Stride$".

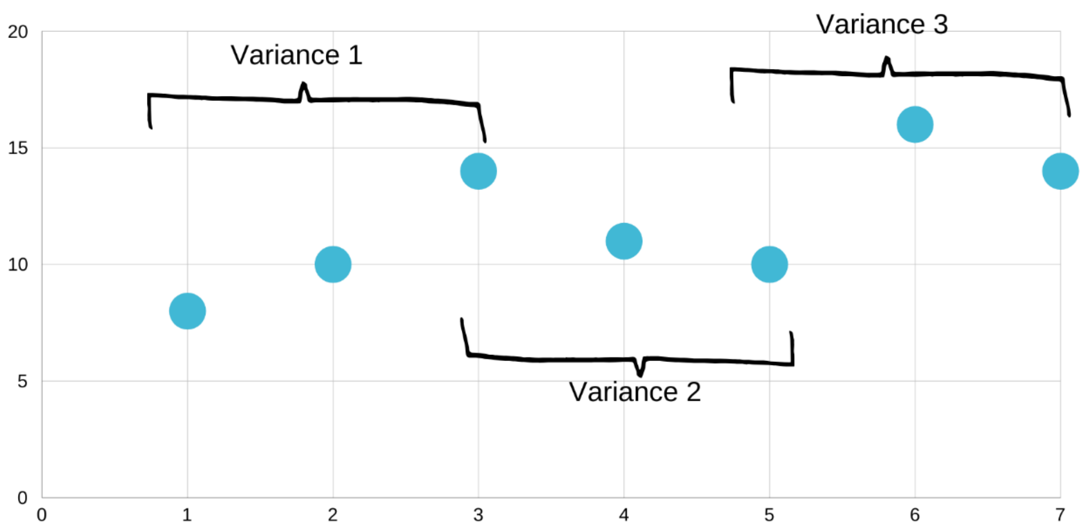
Mathematically, we can express $Fluctuation$ as:

$$Fluctuation(V, L, S) = \frac{1}{\left\lfloor \frac{\text{len}(V)-L}{S} \right\rfloor} \sum_{i=1}^{\left\lfloor \frac{\text{len}(V)-L}{S} \right\rfloor} \text{var}(V[i : i+L])$$

where:

- V represents the list of values.
- L denotes the time lag, or the length of each contiguous subsequence.
- S signifies the step size, determining the spacing between consecutive subsequences.
- $\text{len}(V)$ denotes the length of the list V.
- $V[i : i+L]$ represents a contiguous subsequence of length L starting at index i.
- $\text{var}(L[i : i+L])$ calculates the variance of the subsequence $L[i : i+L]$.

Illustrative Diagram



Fluctuations(V , L = 3, S = 2) = Average of all Variances

Interpreting Fluctuations

A higher value of Fluctuations indicates greater variability within the data, with each contiguous subsequence exhibiting significant variance. Conversely, a lower fluctuations suggests more uniformity or stability in the sequential arrangement of data points. By analysing Fluctuations, we can discern patterns, trends, or irregularities that may not be apparent when solely considering traditional measures of variability.

Conclusion

In conclusion, the measure of fluctuations complements traditional measures of variability by considering the sequential nature of data. By incorporating fluctuations into data analysis, researchers can enhance their understanding of complex processes and uncover valuable insights that may have remained hidden otherwise. Understanding and utilizing the measure of fluctuations is essential for advancing our understanding of the dynamic nature of data.