Using Moving Averages To Pave The Neutrosophic Time Series

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Abstract

In this paper, were using moving averages to pave the Neutrosophic time series. similar to use moving averages to pave the classical time series . the difference, here were dealing with inaccurate data and values of the time series.in the Neutrosophic time series, each unit of time(t) corresponds to a range of values instead of a single value. Finally, we find that the Neutrosophic time series provide an accurate description of the behavior of the series better than in the classic. Therefore, can predict the future of the series as accurately as possible.

Keywords: Time Series, Neutrosophic logic, Neutrosophic Time Series, moving averages.

1.Introduction

A time series is a set of data arranged in chronological order, the data of this series are associate to each other in the general case, and this correlation gives us reliable future forecasts. also define it as a set of consecutive values (observations) that describe the evolution of a phenomenon over time. say about this time series that it is **neutrosophic time series (NTS)**, if some or all of its values (its observations) are not explicitly specific, such as being a range of values instead of one value [9]. That is, successive observations "that describe the evolution of a phenomenon with time" , some or all of it is not precisely defined .

The neutrosophic logic was established by F. Smarandache in 1995 . It is a new branch of philosophy, presented as a generalization for the fuzzy logic [1] and as a generalization for the intuitionistic fuzzy logic [3]. Where presented it as a type of formal logic that aims at explaining the truth, falsehood, and neutral propositions .

The fundamental concepts of neutrosophic set, introduced by Smarandache in [4,5,6,8], Salama and rafif et al. in [7,9,10,11,12,13,14,15,16,17], provides a new foundation for dealing with issues that have indeterminate data. The idea of basic neutrosophic statistics was developed by F. Smarandache [2]. The idea of inferential neutrosophic statistics and neutrosophic statistics was developed by Aslam [18,19]. Singh and Hong presented the time series dataset in to Neutrosophic series using three different memberships are truth-membership, indeterminacy-membership and falsity-membership[23]. In this paper, the authors provide a method for paving the Neutrosophic time series using "forward, backward and central" moving averages. This is done similarly to that in classical logic, with the difference that dealing with a Neutrosophic series rather than a classic series.

The aim of this paper is to demonstrate the method of "paving time series using moving averages" within the framework of the Neutrosophic logic.Where find that dealing with the Neutrosophic series is better than the classic

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series , because the Neutrosophic series provides a more accurate and comprehensive description of the time series data set and thus describe the series behavior better than it is in the classic. Which provides a better environment and base for future forecasting.

Moving averages mean dividing the series into a number of equal and overlapping divisions, and replacing each section with a number (mean, median, or others).

2. The forward moving averages of a Neutosophic time series:

Symbolize the moving averages of a Neutrosophic time series with the symbol Nm_t.

If denote to the Neutrosophic time series with the symbol NQ_t, the forward moving average is given by:

$$Nm_t = \frac{1}{n}\left[\sum_{i=t}^{t+n-1} NQ_i\right] \qquad (2,1)$$

Where n is the degree of the moving average.

For example, for n = 3 we have:

$$Nm_t = \frac{1}{3}\left[\sum_{i=t}^{t+2} NQ_i\right] = \frac{1}{3}[NQ_t + NQ_{t+1} + NQ_{t+2}]$$

Therefore:

$$Nm_1 = \frac{1}{3}[NQ_1 + NQ_2 + NQ_3]$$

$$Nm_2 = \frac{1}{3}[NQ_2 + NQ_3 + NQ_4]$$

And so on..

2.1. Example:

Let's calculate the forward triple moving average for the following Neutrosophical time series, a series that represents the humidity recorded during seven days in Homs:

t	NQ_t	Nm_t
1	[50 , 52]	$=\frac{1}{3}\left[[50,52] + [51,53] + [49,50]\right] = [50, 51.67]$
2	[51 , 53]	$=\frac{1}{3}\left[[51,53] + [49,50] + [55,58]\right] = [51.67, 53.67]$
3	[49 , 50]	=[54.67 , 56.67]
4	[55 , 58]	=[58 , 61]
5	[60 , 62]	=[61 , 64]
6	[59 , 63]	
7	[64 , 67]	

Table (1): Calculating the forward moving average

3. Backward Moving Averages of a Neutrosophic Time Series:

The Backward moving average for a Neutrosophic time series is given by the following relationship:

$Nm_t = \frac{1}{n}\left[\sum_{i=t}^{t-n+1} NQ_i \right]$ **(3,1)**

Where n is the degree of the moving average**.**

For example, for n = 3 we have:

$$Nm_t = \frac{1}{3}\left[\sum_{i=t}^{t-2} NQ_i \right] = \frac{1}{3}[NQ_t + NQ_{t-1} + NQ_{t-2}]$$

Therefore**:**

$$Nm_3 = \frac{1}{3}[NQ_3 + NQ_2 + NQ_1]$$

$$Nm_4 = \frac{1}{3}[NQ_4 + NQ_3 + NQ_2]$$

And so on..

3.1. Example:

Let's calculate the Backward triple moving average for the Neutrosophical time series in the previous example (2.1):

t	NQ_t	Nm_t
1	[50 , 52]	
2	[51 , 53]	
3	[49 , 50]	$= \frac{1}{3}\left[[50, 52] + [51, 53] + [49, 50] \right] = [50, 51.67]$
4	[55 , 58]	$= \frac{1}{3}\left[[51, 53] + [49, 50] + [55, 58] \right] = [51.67, 53.67]$
5	[60 , 62]	=[54.67 , 56.67]
6	[59 , 63]	=[58 , 61]
7	[64 , 67]	=[61 , 64]

Table 2: Calculating the Backward moving average

4. Central moving average of a Neutrosophic time series:

The central moving average of a Neutrosophic time series is given by the following relationship:

$Nm_t = \frac{1}{n}\left[\sum_{i=t-(n-1)/2}^{t+(n-1)/2} NQ_i \right]$ (4,1)

Where n is the degree of the moving average**.**

For example, for n = 3 we have:

$$Nm_t = \frac{1}{3}\left[\sum_{i=t-1}^{t+1} NQ_i \right] = \frac{1}{3}[NQ_{t-1} + NQ_t + NQ_{t+1}]$$

Therefore**:**

$$Nm_2 = \frac{1}{3}[NQ_1 + NQ_2 + NQ_3]$$

$$Nm_3 = \frac{1}{3}[NQ_2 + NQ_3 + NQ_4]$$

For example, for n = 5 we have:

$$Nm_t = \frac{1}{5}\left[\sum_{i=t-2}^{t+2} NQ_i \right]$$

And so on..

4.1. Example:

Let's calculate the central triple moving average for the Neutrosophical time series in the previous example (2.1):

t	NQ_t	Nm_t
1	[50 , 52]	
2	[51 , 53]	= [50 , 51.67]
3	[49 , 50]	= [51.67 , 53.67]
4	[55 , 58]	=[54.67 , 56.67]
5	[60 , 62]	=[58 , 61]
6	[59 , 63]	=[61 , 64]
7	[64 , 67]	

Table 3: Calculating the central moving average

5. Note:

Through the previous three tables (1),(2),(3) we find that:

- When using the forward moving average, lose from the end of the series a number of values equal to (n-1) value, (in our example the degree of Moving average n = 3, so lost two values from the end of the series).
- When using the backward moving average, lose from the beginning of the series a number of values equal to (n-1) value, (in our example the degree of Moving average n = 3, so lost two values from the beginning of the series).

- When using the central moving average, lose from the beginning of the series and at the end of it a number of values equal to (n-1)/2 value, (in our example the degree of moving average n = 3, therefore lost a value from the beginning of the series and a value from the end of the series).

6. Graphical representation of the time series:

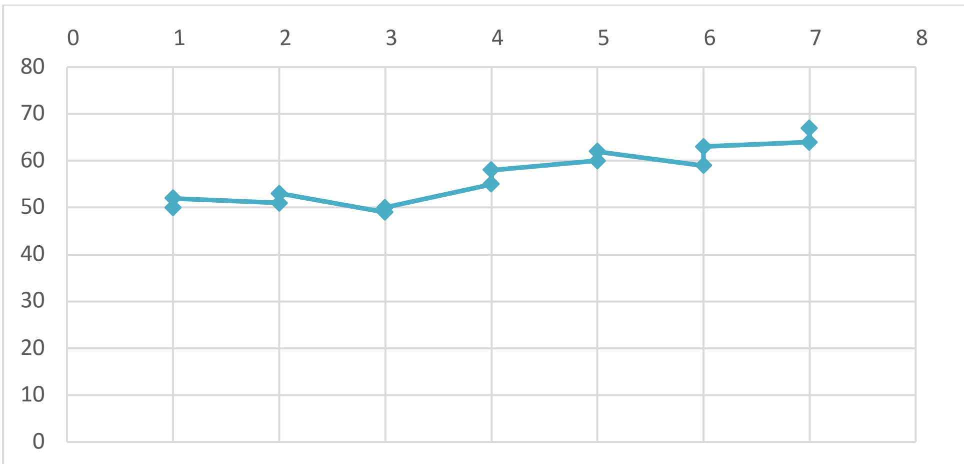

Figure 1. Before paving

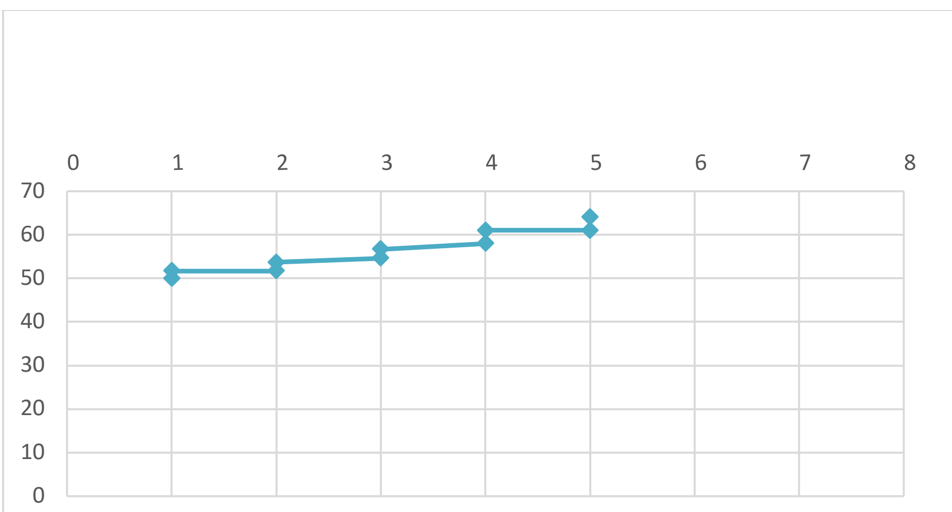

Figure 2. After paving

- **conclude from Figures (1) and (2):** That the graph line in the series after paving has become smoother than the graph line in series before paving .

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- The diagram of the series did not merge "before and after the paving " into a single diagram until the Neutrosophical values appear clearly and do not cause any confusion.
- Was used the forward moving average in the graph.

7. Conclusion

conclude that the use of the Neutrosophic time series and paving them using the moving averages method provides us with a complete and accurate description of the behavior of the time series, which facilitates the prediction process for the future of this series, as well as the prediction process is performed accurately and with the least possible errors.

In the near future, we are looking forward to studying the seasonal, periodic and random changes of neutrosophic time series, as well as the method of eliminating the seasonal effect of neutrosophic time series.

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