Neutrosophic Systems with Applications, Vol. 14, 2024
https://doi.org/10.61356/j.nswa.2024.119

Neutrosophic Statistical Analysis of Temperatures of Cities in the Southeastern Anatolia Region of Turkey

Hacer Şengül Kandemir [1,*], Nazlım Deniz Aral [2], Murat Karakaş [3] and Mikail Et [4]

[1] Faculty of Education; Harran University, Osmanbey Campus 63190, Şanlıurfa, Turkey; hacersengul@harran.edu.tr.
[2,3] Department of Mathematics, Bitlis Eren University, Bitlis, Turkey; ndaral@beu.edu.tr; mkarakas@beu.edu.tr.
[4] Department of Mathematics, Fırat University 23119, Elazığ, Turkey; met@firat.edu.tr.

* Correspondence: hacersengul@harran.edu.tr.

Abstract: In the paper, neutrosophic statistical analysis of temperature data of different cities in the southeastern anatolia region of Turkey is given. The neutrosophic mean and neutrosophic coefficient of variation are computed using the temperature data. From the analysis, it is concluded that the temperatures of Mardin and Şanlıurfa cities are more consistent than the other cities in Turkey. In addition, the neutrosophic results are compared with results under classical statistics. Based on the comparative study, it can be concluded that neutrosophic statistical results are more adequate, flexible and more informative than the classical statistics.

Keywords: Neutrosophic Sets; Neutrosophic Statistics; Temperature; Indeterminacy.

1. Introduction

The geographical features of the world have changed several times in the process until the emergence of people on the stage of history. In certain periods, depending on the deterioration of the natural balance between the elements of our world due to various reasons, there have been great changes in the climate. As a matter of fact, in the period from the beginning of human history to the present, the natural and human environment that lived in the glacial and interglacial periods, when the earth was covered with glaciers, was greatly affected. It is certain that human influences have also contributed to these changes, which are related to natural factors, since the middle of the 19th century.

Today, it is accepted by almost all climate scientists that there is a deterioration in the world climate system. It is clearly stated that if various activities of the people causing the deterioration of the natural balance continue without taking the necessary precautions, these deteriorations in the climate will increase and there will be climatic changes due to global warming, the result of which may be very negative. Because, due to human reasons, the increase in greenhouse gas accumulations and particles in the atmosphere, the destruction of the natural environment, the depletion of the ozone layer, will cause a global temperature increase.

Turkey is one of the countries that will be most affected by a possible climate change within its complex climate structure, especially due to global warming. It is naturally surrounded by seas on three sides and has a faulty topography. Different regions of Turkey will be affected by climate change differently and to varying extents due to its orographic characteristics. For example, arid and semi-arid regions such as South East and Central Anatolia, which are under the threat of desertification rather than temperature increase, and semi-humid Aegean and Mediterranean regions that do not have sufficient water will be more affected. The climatic changes that will occur will cause changes in the natural habitats of animals and plants in agricultural activities, and important problems will arise in terms of water resources, especially in our regions mentioned above.

In recent years, many heat strokes have been recorded, causing many problems in the environment. Animals die because of water due to environmental change. Statistical methods are widely applied for estimation and estimation of temperature. Several researchers have also studied different aspects of temperature. Öztürk [1] examined global climate change and its possible effects on Turkey. Kaygusuz [2] studied on the energy policy and climate change in Turkey. Afzal et al. [3] presented the analysis of resistance depending on the temperature variance of conducting material under the neutrosophic statistical analysis. Further, Janjua et al. [4] worked on the climate variability and wheat crop under neutrosophic environment and Shahzadi [5] presented neutrosophic statistical analysis of temperature data of five different cities of Pakistan. Various studied in this concept with applications can be seen in [6, 7].

Inspired by the reasons mentioned above, and the analysis presented by [5], the main focus of the paper was to neutrosophic statistical analysis of temperature data of different cities. This study is the first in this concept for the southeastern anatolia region of Turkey. It is expected that neutrosophic statistical results are more adequate and informative than the classical statistics.

1.1 Organization of this paper

This paper is organized as follows: a literature review and some definitions and notations are given in the next section. In Section 3, collected temperature data from different cities in the southeastern anatolia region of Turkey like Adıyaman, Batman, Diyarbakır, Gaziantep, Kilis, Mardin, Siirt, Şanlıurfa, Şırnak and the data is reported in Table 1 which presents low and high values of the temperature data. We performed the neutrosophic statistical analysis using the temperature data and calculated the neutrosophic mean of temperature, the neutrosophic standard deviation, the neutrosophic coefficient variation in Section 4. Section 5 contained a comparative discussion about neutrosophic statistical analysis and classical statistical analysis. At last, a conclusion of this work was given in Section 6.

2. Methodology

Let X_{iN} is the neutrosophic numbers having X_{iL} lower values and X_{iU} higher values, so the neutrosophic formula for the ith interval:

$$X_{iN} = X_{iL} + X_{iU} I_N \ \ (i = 1,2,3, \dots, n_N)$$

Here $I_N \in [I_L, I_U]$ and $X_N \in [X_L, X_U]$ is a random neutrosophic variable having size $n_N \in [n_L, n_U]$. The variable $X_{iN} \in [X_{iL}, X_{iU}]$ has two parts: lower value X_{iL} a classical part, and upper-value $X_{iU} I_N$ an indeterminate part having indeterminacy interval $I_N \in [I_L, I_U]$.
Similarly, Chen et al. [8, 9] and Aslam [10] the neutrosophic average of temperature data $\overline{X}_N \in [\overline{X}_L, \overline{X}_U]$ can be calculated as

$$\overline{X}_N = \overline{X}_L + \overline{X}_U I_N \ ; \ I_N \in [I_L, I_U]$$

where

$$\overline{X}_U = \frac{1}{n_L} \sum_{i=1}^{n_L} X_{iL} \ ,$$
$$\overline{X}_L = \frac{1}{n_U} \sum_{i=1}^{n_U} X_{iU}.$$

NNs and neutrosophic statistics are firstly proposed by Smarandache [11-13]. However, it is difficult to use the Smarandache's neutrosophic statistics for engineering applications. Thus, Ye et al. [14] presented some new operations of NNs to make them suitable for engineering applications.

Let NNs be $z_1 = a_1 + b_1 I$ and $z_2 = a_2 + b_2 I$ for $I_N \in [I_L, I_U]$. Then, Ye et al. [14] proposed their basic operations:

$$z_1 + z_2 = (a_1 + a_2) + (b_1 + b_2)I = [a_1 + a_2 + b_1 I_L + b_2 I_L, a_1 + a_2 + b_1 I_U + b_2 I_U];$$

$$z_1 - z_2 = (a_1 - a_2) + (b_1 - b_2)I = [a_1 - a_2 + b_1 I_L - b_2 I_L, a_1 - a_2 + b_1 I_U - b_2 I_U]; \quad (1)$$

$$z_1 \times z_2 = a_1a_2 + (a_1b_2 + a_2b_1)I + (b_1b_2)I^2$$

$$= \begin{bmatrix} min\begin{pmatrix} (a_1 + b_1I_L)(a_2 + b_2I_L), (a_i + b_iI_L)(a_2 + b_2I_U) \\ (a_1 + b_1I_U)(a_2 + b_2I_L), (a_i + b_iI_U)(a_2 + b_2I_U) \end{pmatrix} \\ max\begin{pmatrix} (a_1 + b_1I_L)(a_2 + b_2I_L), (a_i + b_iI_L)(a_2 + b_2I_U) \\ (a_1 + b_1I_U)(a_2 + b_2I_L), (a_i + b_iI_U)(a_2 + b_2I_U) \end{pmatrix} \end{bmatrix}$$

$$\frac{z_1}{z_2} = \frac{a_1 + b_1I}{a_2 + b_2I} = \frac{[a_1 + b_1I_L, a_1 + b_1I_U\ ]}{[a_2 + b_2I_L, a_2 + b_2I_U]}$$

$$= \begin{bmatrix} min\left(\frac{a_1+b_1I_L}{a_2+b_2I_U}, \frac{a_1+b_1I_L}{a_2+b_2I_L}, \frac{a_1+b_1I_U}{a_2+b_2I_U}, \frac{a_1+b_1I_U}{a_2+b_2I_L}\right) \\ max\left(\frac{a_1+b_1I_L}{a_2+b_2I_U}, \frac{a_1+b_1I_L}{a_2+b_2I_L}, \frac{a_1+b_1I_U}{a_2+b_2I_U}, \frac{a_1+b_1I_U}{a_2+b_2I_L}\right) \end{bmatrix}.$$

Then, these basic operations are different from the ones introduced in [12] and this makes them suitable for engineering applications. Based on Eq. (1), we can give the neutrosophic statistical algorithm of the neutrosophic average value and standard deviation of NNs.
Let $z_i = a_i + b_iI$ (i = 1,2,…, n) be a group of NNs (neutrosophic numbers) for $I_N \in [I_L, I_U]$ then their neutrosophic average value and standard deviation can be calculated by the following neutrosophic statistical algorithm:

Step 1. Calculate the neutrosophic average value of a_i (i = 1,2,…, n):

$$\overline{a} = \frac{1}{n}\sum_{i=1}^{n} a_i \quad (2)$$

Step 2. Calculate the neutrosophic average value of b_i (i = 1,2,…, n):

$$\overline{b} = \frac{1}{n}\sum_{i=1}^{n} b_i \quad (3)$$

Step 3. Obtain the neutrosophic average value:

$$\overline{z}_N = \overline{a} + \overline{b}I_N \ ;\ I_N \in [I_L, I_U] \quad (4)$$

Step 4. Get the differences between z_i (i = 1,2,…, n) and $\overline{z}$:

$$z_i - \overline{z} = a_i - \overline{a} + (b_i - \overline{b})I_N \ ,\ I_N \in [I_L, I_U]$$

Step 5. Calculate the square of all the differences between z_i (i = 1,2,…, n) and $\overline{z}$:

$$(z_i - \overline{z})^2 = \begin{bmatrix} min\begin{pmatrix} (a_i + b_iI_L)(\overline{a} + \overline{b}I_L), (a_i + b_iI_L)(\overline{a} + \overline{b}I_U) \\ (a_i + b_iI_U)(\overline{a} + \overline{b}I_L), (a_i + b_iI_U)(\overline{a} + \overline{b}I_U) \end{pmatrix} \\ max\begin{pmatrix} (a_i + b_iI_L)(\overline{a} + \overline{b}I_L), (a_i + b_iI_L)(\overline{a} + \overline{b}I_U) \\ (a_i + b_iI_U)(\overline{a} + \overline{b}I_L), (a_i + b_iI_U)(\overline{a} + \overline{b}I_U) \end{pmatrix} \end{bmatrix},\ I_N \in [I_L, I_U]$$

Step 6. Calculate the neutrosophic standard deviation:

$$\sigma_z = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(z_i - \overline{z})^2} \ \text{[8].}$$

The neutrosophic variance can be computed by;

$$\sigma_z^2 = \frac{1}{n}\sum_{i=1}^{n}(z_i - \overline{z})^2 \ ,\ \text{i} = 1,2,\ldots,\text{n}$$

where $\sigma_z^2 \in [\sigma_{zL}^2, \sigma_{zU}^2]$. The neutrosophic form of $\sigma_z^2 \in [\sigma_{zL}^2, \sigma_{zU}^2]$ can be written as

$$a_S + b_SI_{NS} \ ;\ I_{NS} \in [I_{LS}, I_{US}].$$

The neutrosophic coefficient of variation (CV_N) can be applied to see the consistency of the temperature in the different cities of the Turkey. A city having a smaller value of CV_N means more consistent than the other city in temperature. The CV_N can be computed by;

$$CV_N = \frac{\sigma_z}{\bar{X}_N} x100 \;\; ; \; CV_N \in [CV_L, CV_U].$$

The neutrosophic form of CV_N is

$$a_\vartheta + b_\vartheta I_{N\vartheta} \;\; ; \; I_{N\vartheta} \in [I_{L\vartheta}, I_{U\vartheta}] \;\; [10].$$

Note that, $z_i = X_N$, $a_i = X_L$ and $b_i = X_U$. We will use the symbols a_i and b_i to present the lower and upper values, respectively throughout the paper.

3. Data Collection

We collected temperature data from different cities in the southeastern anatolia region of Turkey like Adıyaman, Batman, Diyarbakır, Gaziantep, Kilis, Mardin, Siirt, Şanlıurfa and Şırnak. Our aim is investigating which city on the average has the best temperature and which city temperature is more consistent. We collected data of February 2023 from the website https://www.gismeteo.com/. The data is reported in Table 1. Table 1 presents low and high values of the temperature data. The temperature data given in the interval cannot be analysed using classical statistics. The interval data can be analysed using neutrosophic statistics. The neutrosophic statistical analysis for the temperature data is shown in Section 3.

Table 1. The low and high values of the temperature data.

		Adıyaman		**Batman**		**Diyarbakır**		**Gaziantep**		**Kilis**		**Mardin**		**Siirt**		**Şanlıurfa**		**Şırnak**	
Day	Date	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Monday	6	1	4	2	6	2	5	-2	4	1	5	4	6	0	4	2	6	-1	2
Tuesday	7	-4	2	1	6	-2	4	-6	1	0	4	1	6	0	2	0	6	-4	1
Wednesday	8	-1	3	-2	3	-4	1	-3	2	1	6	0	6	-4	0	2	6	-6	1
Thursday	9	-2	4	-1	5	-5	3	-4	3	1	6	1	7	-4	3	1	6	-6	2
Friday	10	-1	5	-1	6	-5	4	-1	5	3	8	1	8	-3	4	1	10	-6	3
Saturday	11	0	4	1	5	-3	1	-2	3	3	5	3	8	-1	4	3	5	-4	3
Sunday	12	3	4	3	6	-1	3	0	4	2	6	4	9	1	4	4	7	1	5
Monday	13	1	9	2	9	-1	4	-1	8	2	11	4	11	1	8	3	12	-2	3
Tuesday	14	2	10	1	8	-4	6	0	10	4	12	2	11	-1	7	4	11	-4	4
Wednesday	15	3	10	1	8	-3	6	1	7	5	11	4	12	-1	8	5	12	-3	6
Thursday	16	4	12	5	13	-1	10	1	11	5	13	7	14	4	11	5	13	2	7
Friday	17	2	9	3	10	0	9	2	10	6	13	6	15	1	9	5	13	2	9
Saturday	18	-1	7	1	9	1	9	2	10	4	11	4	12	-1	6	3	11	0	8
Sunday	19	-1	8	1	9	1	10	2	12	4	13	4	13	-1	7	2	13	0	8
Monday	20	0	6	1	8	1	8	3	9	5	11	4	12	-1	6	3	10	0	8
Tuesday	21	-1	6	1	8	0	8	2	9	4	11	4	12	-1	6	2	10	1	7
Wednesday	22	-1	9	0	9	0	10	2	12	4	13	3	13	-2	7	2	12	0	8
Thursday	23	0	10	1	10	1	11	3	13	4	14	3	14	-1	7	3	14	0	8
Friday	24	2	11	2	11	3	12	5	14	6	15	5	15	0	9	5	15	1	10
Saturday	25	3	12	3	12	4	13	6	17	7	17	5	16	2	10	5	17	2	11
Sunday	26	4	12	3	12	4	12	7	16	9	17	7	16	1	10	6	16	2	12

4. Results and Interpretation

We performed the neutrosophic statistical analysis using the temperature data. The neutrosophic mean of temperature is shown in Table 2. The neutrosophic standard deviation is shown in Table 3. The neutrosophic coefficient variation is shown in Table 4. For example, the neutrosophic average temperature value and the standard deviation of Adıyaman city is calculated. Then, we give the following calculational steps based on the neutrosophic statistical algorithm.

Step 1. By Eq. (2), calculate the average value of the determinate low temperature of city corresponding to the first column as follows:

$$\overline{a}_1 = \frac{1}{n}\sum_{i=1}^{n} a_{i1} = \frac{1}{21}\sum_{i=1}^{21} a_{i1}$$

$$= \frac{(1-4-1-2-1+0+3+1+2+3+4+2-1-1+0-1-1+0+2+3+4)}{21} = 0{,}666$$

Step 2. By Eq. (3), calculate the average value of the determinate high temperature of city corresponding to the first column as follows:

$$\overline{b}_1 = \frac{1}{n}\sum_{i=1}^{n} b_{i1} = \frac{1}{21}\sum_{i=1}^{21} b_{i1}$$

$$= \frac{(4+2+3+4+5+4+4+9+10+10+12+9+7+8+6+6+9+10+11+12+12)}{21}$$

$$= 7.476$$

Step 3. By Eq. (4), obtain the neutrosophic average temperature value of Adıyaman city:
$\overline{z}_1 = \overline{a}_1 + \overline{b}_1 I_N = 0{,}666 + 7.476 I_N,\ I_N \in [0{,}0.91]$. The neutrosophic mean of temperature is shown in Table 2.

Table 2. The neutrosophic mean of temperature.

Cities	$\overline{z}_i$	$\overline{a}_i + \overline{b}_i I_N,\ I_N \in [I_L, I_U]$
Adıyaman	$[0.66, 7.47]$	$0.66 + 7.47 I_N, I_N \in [0{,}0.91]$
Batman	$[1.33, 8.23]$	$1.33 + 8.23 I_N, I_N \in [0{,}0.83]$
Diyarbakır	$[-0.57, 7.09]$	$-0.57 + 7.09 I_N,\ I_N \in [0{,}1.08]$
Gaziantep	$[0.80, 8.57]$	$0.80 + 8.57 I_N, I_N \in [0{,}0.90]$
Kilis	$[3.80, 10.57]$	$3.80 + 10.57 I_N, I_N \in [0{,}0.63]$
Mardin	$[3.61, 11.23]$	$3.61 + 11.23 I_N,\ I_N \in [0{,}0.67]$
Siirt	$[-0.52, 6.28]$	$-0.52 + 6.28 I_N, I_N \in [0{,}1.08]$
Şanlıurfa	$[3.14, 10.71]$	$3.14 + 10.71 I_N, I_N \in [0{,}0.70]$
Şırnak	$[-1.19, 6]$	$-1.19 + 6 I_N,\ I_N \in [0{,}1.19]$

Step 4. Obtain the differences between z_i $(i = 1,2,\ldots,n)$ and $\overline{z}_i$ of Adıyaman city:

$$z_1 - \overline{z}_1 = a_1 - \overline{a}_1 + (b_1 - \overline{b}_1) I_N = (1 - 0.66) + (4 - 7.47) I_N$$

$$z_1 - \overline{z}_1 = 0.34 + (-3.47) I_N\ ,\ I_N \in [0{,}1.09]$$

$$\vdots$$

$$z_{21} - \overline{z}_1 = 3.34 + 4.53I_N \ , \ I_N \in [0,0.26].$$

Step 5. Calculate the square of all the differences between z_i $(i = 1,2,\dots,n)$ and $\overline{z}_i$:

$$(z_i - \overline{z}_1)^2 = \begin{bmatrix} min\big((a_1 - \overline{a}_1)^2, (a_1 - \overline{a}_1)((a_1 - \overline{a}_1) + 1.09x(b_1 - \overline{b}_1)), ((a_1 - \overline{a}_1) + 1.09x(b_1 - \overline{b}_1))^2\big) \\ max\big((a_1 - \overline{a}_1)^2, (a_1 - \overline{a}_1)((a_1 - \overline{a}_1) + 1.09x(b_1 - \overline{b}_1)), ((a_1 - \overline{a}_1) + 1.09x(b_1 - \overline{b}_1))^2\big) \end{bmatrix}$$

$$= \left[(a_1 - \overline{a}_1)^2, \left((a_1 - \overline{a}_1) + 1.09x(b_1 - \overline{b}_1)\right)^2\right] = [0.116, 11.847], \ I_N \in [0,1.09]$$

$$\vdots$$

$$(z_{21} - \overline{z}_1)^2 = [11.15, 20.41], \ I_N \in [0,0.26].$$

Step 6. Calculate the neutrosophic standard deviation:

$$\sigma_{z1} = \sqrt{\frac{1}{21}\sum_{i=1}^{21}(z_i - \overline{z}_1)^2} = \left[\sqrt{\frac{1}{21}(0.116 + \dots + 11.15)}, \sqrt{\frac{1}{21}(11.847 + \dots + 20.43)}\right]$$

The neutrosophic standard deviation is shown in Table 3. Also, the neutrosophic coefficient variation is shown in Table 4.

Table 3. The neutrosophic standard deviation.

Cities	$\boldsymbol{\sigma_z}$	$\boldsymbol{a_s + b_s I_{Ns},\ I_{Ns} \in [I_{Ls}, I_{Us}]}$
Adıyaman	$[2.04, 3.06]$	$2.04 + 3.06I_N, I_N \in [0,0.33]$
Batman	$[1.54, 2.56]$	$1.54 + 2.56I_N, I_N \in [0,0.40]$
Diyarbakır	$[2.58, 6.47]$	$2.58 + 6.47I_N, I_N \in [0,0.60]$
Gaziantep	$[3.13, 7.08]$	$3.13 + 7.08I_N, I_N \in [0,0.55]$
Kilis	$[2.14, 4.49]$	$2.14 + 4.49I_N, I_N \in [0,0.52]$
Mardin	$[1.83, 3.77]$	$1.83 + 3.77I_N, I_N \in [0,0.51]$
Siirt	$[1.87, 4.55]$	$1.87 + 4.55I_N, I_N \in [0,0.58]$
Şanlıurfa	$[1.54 , 3.69]$	$1.54 + 3.69I_N, I_N \in [0,0.58]$
Şırnak	$[2.71, 6.35]$	$2.71 + 6.35I_N, I_N \in [0,0.57]$

Table 4. The neutrosophic coefficient variation.

Cities	$\boldsymbol{CV_N}$	$\boldsymbol{a_v + b_v I_{Nv},\ I_{Ns} \in [I_{Lv}, I_{Uv}]}$
Adıyaman	$[40.96, 309.09]$	$40.96 + 309.09I_N, I_N \in [0,0.87]$
Batman	$[31.10, 115.79]$	$31.10 + 115.79I_N, I_N \in [0,0.73]$
Diyarbakır	$[-452.63, 91.25]$	$-452.63 + 91.25I_N, I_N \in [0,5.96]$
Gaziantep	$[82.61, 391.25]$	$82.61 + 391.25I_N, I_N \in [0,0.79]$
Kilis	$[42.48, 56.31]$	$42.48 + 56.31I_N, I_N \in [-0.24,0]$
Mardin	$[33.57,50.69]$	$33.57 + 50.69I_N, I_N \in [0,0.33]$
Siirt	$[-359.61, 72.45]$	$-359.61 + 72.45I_N, I_N \in [0,5.96]$
Şanlıurfa	$[34.45, 49.04]$	$34.45 + 49.04I_N, I_N \in [0,0.297]$
Şırnak	$[-227.73, 105.83]$	$-227.73 + 105.83I_N, I_N \in [0,3.15]$

The measures of indeterminacy associated with the coefficient of variation are also shown in Table 4. Based on the analysis, it can be concluded that the values of the coefficient of variation of temperature in Mardin and Şanlıurfa are minimum. Therefore, the temperatures of Mardin and Şanlıurfa cities are more consistent than the other cities in Turkey. Figures 1-3, present the neutrosophic average values, standard deviations, coefficient variations of temperatures in different cities, respectively.

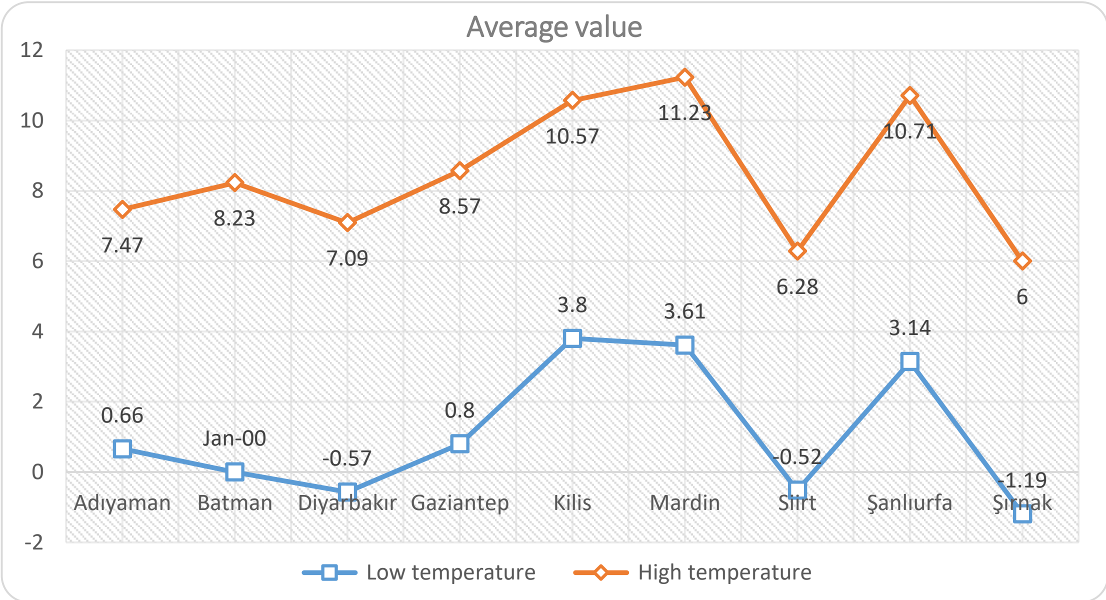

Figure 1. The neutrosophic average values of temperatures in different cities.

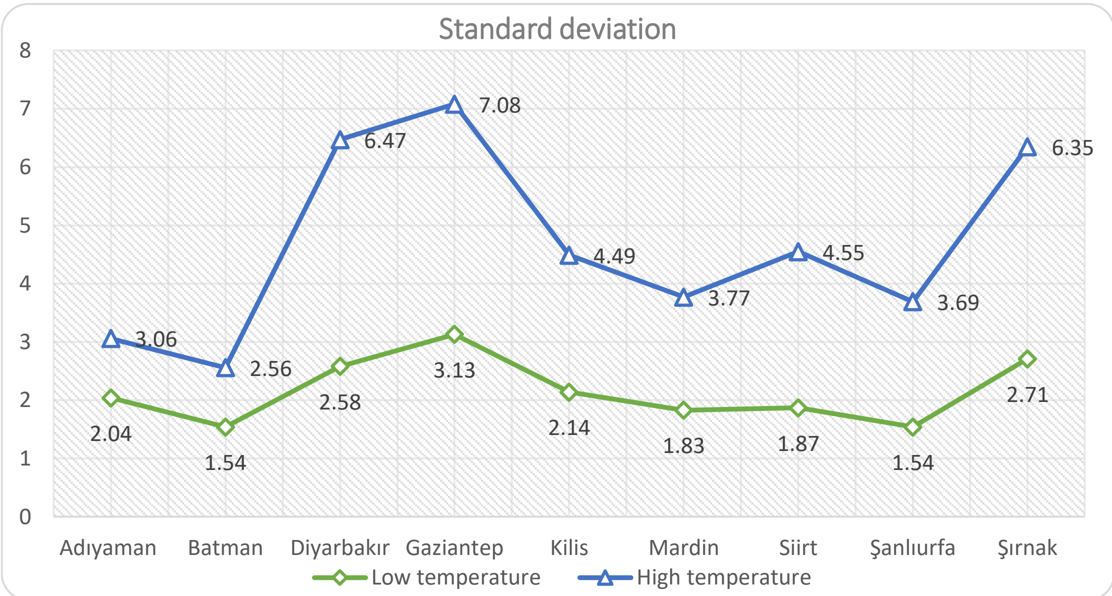

Figure 2. The neutrosophic standard deviations of temperatures in different cities

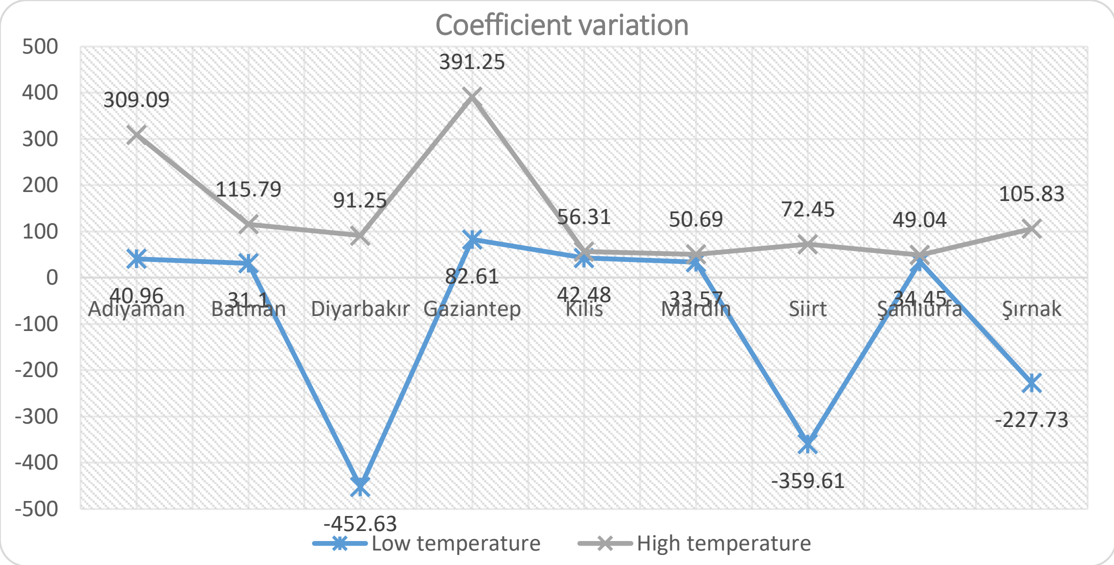

Figure 3. The neutrosophic coefficient variations of temperatures in different cities.

5. Comparative study

The neutrosophic statistical analysis is the generalization of the classical statistical analysis. The neutrosophic statistical analysis reduces to classical statistical analysis when no indeterminacy is found in the data or data is not recorded in the intervals. Note here that temperature data is always recorded in intervals and therefore adequately analysed by the neutrosophic statistics. We now compare the results obtained using neutrosophic statistics with the results of classical statistics. The neutrosophic forms of the temperatures of Mardin and Şanlıurfa cities are $CV_N = 33.57 + 50.69I_N$ and $CV_N = 34.45 + 49.04I_N$. The first values (determinate) 33.57 and 34.45 of this neutrosophic show the analysis from the classical statistics while the second part $50.69I_N$ and $49.04I_N$ of the neutrosophic forms show the indeterminate part. From the analysis, it can be seen that the values CV_N ranges from 33.57% to 50.69% and 34.45% to 49.04% with the measure of indeterminacy or uncertainties at 0.33 and 0.297. Note that when I_{N_v}, the neutrosophic statistical results reduce to the results under classical statistics.

6. Conclusion

In this work, we applied neutrosophic statistical analysis to temperature data of different cities of Turkey. Based on the comparative study, it can be concluded that neutrosophic statistical results are more adequate, flexible and more informative than the classical statistics. Serious steps should be taken to reduce global warming by planting more trees, especially in Mardin and Şanlıurfa cities. The neutrosophic statistical analysis can be applied to analyse the interval data more adequately than classical statistics. Also, in future studies the work can be extended for all regions of Turkey. Furthermore, this calculated can be used humidity, amount of rainfall etc. for different regions of Turkey.

Acknowledgments

This projected work was partially (not financial) supported by Harran University with the project HUBAP ID: 22261.

The authors acknowledge that some of the results were presented at the 6th International Hybrid Conference on Mathematical Advances and Applications (ICOMAA 2023) May, 10-13, 2023 Yildiz Technical University, Istanbul, Turkey [15].

Data availability

The datasets generated during and/or analyzed during the current study are not publicly available due to the privacy-preserving nature of the data but are available from the corresponding author upon reasonable request.

Conflict of interest

The authors declare that there is no conflict of interest in the research.

Funding

This research received no external funding.

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

References

1. Öztürk, K. (2002). Küresel İklim Değişikliği ve Türkiye'ye Olası Etkileri. G.Ü. Gazi Eğitim Fakültesi Dergisi, (22)1, 47-65.
2. Kaygusuz, K. (2003). Energy policy and climate change in Turkey. Energy Conversion and Management, (44), 1671–1688. https://doi.org/10.1016/S0196-8904(02)00170-X.
3. Afzal, U., Alrweili, H., Ahamd, N., & Aslam, M. (2021). Neutrosophic statistical analysis of resistance depending on the temperature variance of conducting material. Scientific reports, (11)1, 1-6. https://doi.org/10.1038/s41598-021-03347-z.
4. Janjua, A. A., Aslam, M., & Ahmed, Z. (2022). Comparative Analysis of Climate Variability and Wheat Crop under Neutrosophic Environment. MAPAN, 37(1), 25-32. https://doi.org/10.1007/s12647-021-00485-7.
5. Shahzadi, I. (2023). Neutrosophic Statistical Analysis of Temperature of Different Cities of Pakistan. Neutrosophic Sets and Systems, 53(1), 157-164. https://digitalrepository.unm.edu/nss_journal/vol53/iss1/.
6. Haque, T. S., Chakraborty, A., Alrabaiah, H., & Alam, S. (2022). Multiattribute decision-making by logarithmic operational laws in interval neutrosophic environments. Journal of Granular Computing, 7(4), 837-860. https://doi.org/10.1007/s41066-021-00299-7.
7. Poulik, S., Ghorai, G. and Xin, Q. (2023). Explication of crossroads order based on Randic index of graph with fuzzy information. Soft Computing, https://doi.org/10.1007/s00500-023-09453-6.
8. Chen, J., Ye, J., & Du, S. (2017). Scale effect and anisotropy analyzed for neutrosophic numbers of rock joint roughness coefficient based on neutrosophic statistics. Symmetry, 9(10), 208. https://doi.org/10.3390/sym9100208.
9. Chen, J., Ye, J., Du, S., & Yong, R. (2017). Expressions of rock joint roughness coefficient using neutrosophic interval statistical numbers. Symmetry, 9(7), 123. https://doi.org/10.3390/sym9070123.
10. Aslam, M. (2019). A new method to analyze rock joint roughness coefficient based on neutrosophic statistics. Measurement, 146, 65-71. https://doi.org/10.1016/j.measurement.2019.06.024.
11. Smarandache, F. (1998). Neutrosophy: Neutrosophic Probability, Set and Logic. American Research Press: Rehoboth, DE, USA.
12. Smarandache, F. (2013). Introduction to Neutrosophic Measure, Neutrosophic Integral, and Neutrosophic Probability. Sitech & Education Publisher: Craiova, Romania.
13. Smarandache, F. (2014). Introduction to Neutrosophic Statistics. Sitech & Education Publisher: Craiova, Romania. https://doi.org/10.48550/arXiv.1406.2000
14. Ye, J. (2018). Neutrosophic number linear programming method and its application under neutrosophic number environments. Soft Comput., 22, 4639-4646. https://doi.org/10.1007/s00500-017-2646-z.

15. Şengul Kandemir, H., Aral, N.D., Karakas, M., & Et, M. (2023). Neutrosophic Statistical Analysis of Temperatures of Cities in the Southeastern Anatolia Region of Turkey, In: 6th International Hybrid Conference on Mathematical Advances and Applications (ICOMAA 2023), May, 10-13, Yildiz Technical University, Istanbul, Turkey.

Received: 14 Oct 2023, **Revised:** 09 Dec 2023,
Accepted: 14 Jan 2024, **Available online:** 17 Jan 2024.