MATHEMATICAL PROCESSING OF METEOROLOGICAL DATA FROM ORADEA MUNICIPALITY

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REVIEW. RESEARCH ARTICLE

Abstract

In this work. having the meteorological data from the Oradea station for the year 2022. we processed them using the parabolic trend of determining the equation of provenance. We processed the average value of the temperatures distributed over the months.

Keywords: medium temperature. parabolic trend.
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INTRODUCTION

The work determines the parabolic trend associated with the data measured at the meteorological station in Oradea, Romania, valid in the year 2022, according to the monthly average of the temperatures, throughout the year and the dew point established at 12 o'clock of the day, which represents the temperature up to which the air wet must cool to become saturated in water vapor.

Table 1, contains the data measured in 2022, the average monthly air temperature, at the meteorological station, from Oradea and dew point, which is extracted from tables based on air temperature and relative humidity. The dew point is extracted in degrees Celsius and is measured at noon of the day distributed over months.

The first stage of determining the trend related to the measured data is based on the graph determined by the measured values. From the measured data, it can be seen that the representation of the graph determined by the average monthly temperature can be approximated with a parabola with downward-facing branches. That is why the measured values for the distinct points i=$\overline{1,12}$, will be processed for the parabolic trend, as in Figure 1 and Figure 2. **Similarly, we graphically represented the dew point related to the months.** I noted with T1 the average monthly temperature and with T2 the temperature determined for the dew point, (Blaga. P. & Mureșan. A. 1996).

Table 1

Average monthly air temperature in degrees Celsius and dew point – for the year 2022 at the Meteorological Station from Oradea city.

Month from 2022 year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
T1=xi	-0.6	4.3	4.9	9.7	17.3	23.1	24.2	24.2	15.9	12.6	7.5	4	147.1
T2= yi	-2.1	0.8	-4.6	4	9.5	11	10.3	13.8	12.3	10	6.7	2.9	74.6

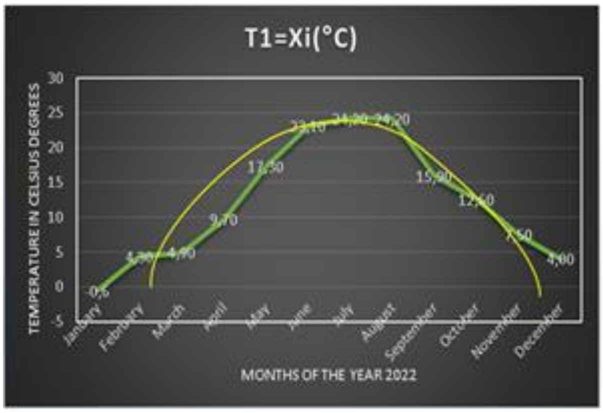

Figure 1 **Establishing the parabolic trend for T1**

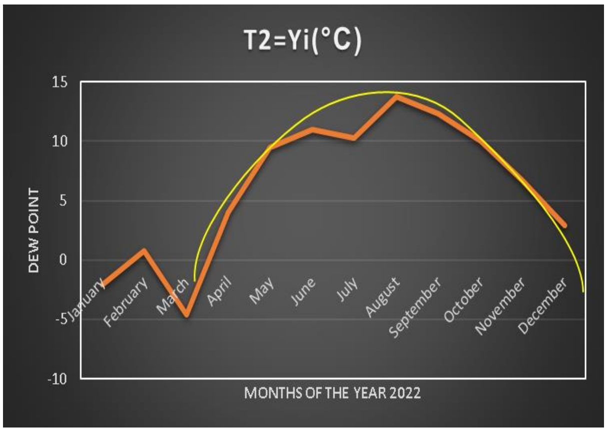

Figure 2 **Establishing the parabolic trend for T2**

$i = \overline{1,12}$. We will consider the dependent variable y_i=T2, which represent monthly dew point for i = $\overline{1,12}$, from the Oradea meteorological station, presented in Table 1 and Tabel 2. We are looking for the representative function of the parabolic trend, function y = f (x; a, b, c) = a·x^2+b·x+c, a, b, c, real numbers, unknown, (Stirețchi, Gh., 1985).

In the second stage, the real unknowns a, b, c, must be determined using" The smallest squares" method. The determination of the parameters is made such that the next sum be minimal:

$$S(a,b,c) = \sum_{i=1}^{12} [f(x_i;a,b,c) - y_i]^2 .$$

To determine the local minimum point, the system must be solved:

$$\begin{cases} \frac{\partial S}{\partial a} = 0 \\ \frac{\partial S}{\partial b} = 0 \\ \frac{\partial S}{\partial c} = 0 \end{cases} .$$

After calculations the system becomes

Table 2

Method calculations

	xi	yi	x_i^2	x_i^3	x_i^4	$x_i \cdot y_i$	$x_i^2 \cdot y_i$
	-0.6	-2.1	0.36	-0.216	0.1296	1.26	-0.756
	4.3	0.8	18.49	79.507	341.8801	3.44	14.792
	4.9	-4.6	24.01	117.649	576.4801	-22.54	-110.446
	9.7	4	94.09	912.673	8852.928	38.8	376.36
	17.3	9.5	299.29	5177.717	89574.5	164.35	2843.255
	23.1	11	533.61	12326.39	284739.6	254.1	5869.71
	24.2	10.3	585.64	14172.49	342974.2	249.26	6032.092
	24.2	13.8	585.64	14172.49	342974.2	333.96	8081.832
	15.9	12.3	252.81	4019.679	63912.9	195.57	3109.563
	12.6	10	158.76	2000.376	25204.74	126	1587.6
	7.5	6.7	56.25	421.875	3164.063	50.25	376.875
	4	2.9	16	64	256	11.6	46.4
TOTAL	147.1	74.6	2624.95	53464.63	1162572	1406.05	28227.28

MATERIAL AND METHOD

We will use the data measured at the Weather Station Oradea, processed in Table 2 and we denote the continuous function f: [a,b] → R, f(x) = y, unknown function. We present numerical data in the Table 1 and processed data in the Table 2, where x_i = T1, represent monthly average of the temperatures of the year 2022, for

$$\begin{cases} \left(\sum_{i=1}^{12} x_i^4\right) \cdot a + \left(\sum_{i=1}^{12} x_i^3\right) \cdot b + \left(\sum_{i=1}^{12} x_i^2\right) \cdot c = \sum_{i=1}^{6} x_i^2 y_i \\ \left(\sum_{i=1}^{12} x_i^3\right) \cdot a + \left(\sum_{i=1}^{12} x_i^2\right) \cdot b + \left(\sum_{i=1}^{12} x_i\right) \cdot c = \sum_{i=1}^{6} x_i \cdot y_i \\ \left(\sum_{i=1}^{12} x_i^2\right) \cdot a + \left(\sum_{i=1}^{12} x_i\right) \cdot b + 12 \cdot c = \left(\sum_{i=1}^{12} y_i\right) \end{cases}$$

Where x_i represent the average monthly air temperature of the year 2022, y_i represent dew point the for i = $\overline{1,12}$, processed in the Table 2, (Blaga. P. & Mureşan. A. 1996).

After replacing with processed temperature data in the Table 2, the system shows:

$$\begin{cases} 1162572 \cdot a + 53464.63 \cdot b + 2624.95 \cdot c = 28227.28 \\ 53464.63 \cdot a + 2624.95 \cdot b + 147.1 \cdot c = 1406.05 \\ 2624.95 \cdot a + 147.1 \cdot b + 12 \cdot c = 74.6 \end{cases}$$

We are note:

$$A = \begin{pmatrix} 1162572 & 53464.63 & 2624.95 \\ 53464.63 & 2624.95 & 147.1 \\ 2624.95 & 147.1 & 12 \end{pmatrix},$$

$$C = \begin{pmatrix} a \\ b \\ c \end{pmatrix},$$

$$L = \begin{pmatrix} 28227.28 \\ 1406.05 \\ 74.6 \end{pmatrix}.$$

The method of solving this system is based on working with matrices, which we have transposed in Matlab, for a much faster solution, (Breaz. N.& Crăciun. M. & Gaşpar. P. & Miroiu. M. & Munteanu. I.P.2011).

So:

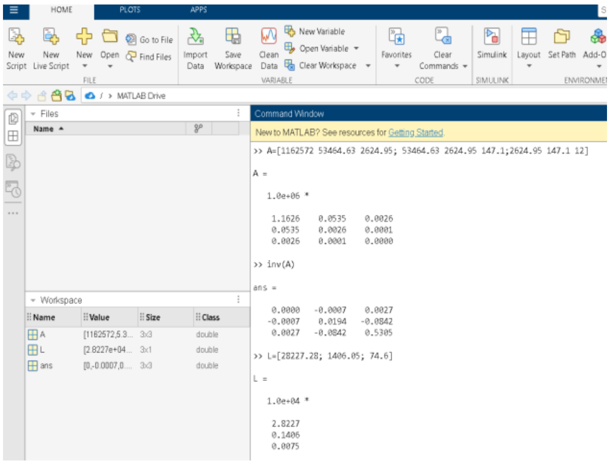

Figure 2 **Method in the Matlab program**

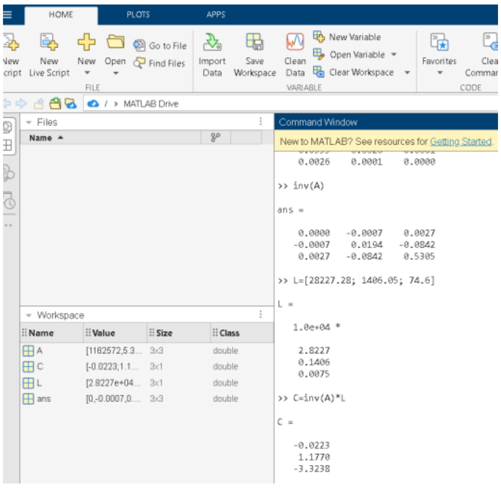

Figure 3 **Solution in the in Matlab program**

The coefficients a, b, c, were determined by solving this system using the matrix equations method, in the Matlab program. The solution obtained is the inverse of the matrix of coefficients by noting with inv(A), multiplied by the matrix of free terms by noting with L from Figure 2 and Figure 3. We deduce that: $a = -0.0223;\ b = 1.177;\ c = -3{,}3238$, from Figure 3. So, the parabolic function of the provenance of the measured data is:

$$f(x) = -0.0223 \cdot x^2 + 1.177 \cdot x - 3{,}3238 = y.$$

This function adjusts the measured data according to the parabolic trend being a quadratic function.

RESULTS AND DISCUSSIONS

The method used is called adjusting the measured numerical data for the parabolic trend, a method used in mathematical statistics and not only. This is a rather painstaking method of processing, since the data characterizing natural phenomena are generally rational numbers with several decimal places. So their processing requires a lot of attention and accuracy. We obtained a quadratic function using the measured data. The unknowns a,b,c are also rational numbers, with the help of which we determine the origin function. It can help us in future predictions, provided that the trend used to characterize this natural phenomenon is preserved. For a more laborious and accurate study we will compare it with other methods in the following papers.

CONCLUSIONS

In this paper, we studied the parabolic trend for the data measured from the weather station in the city of Oradea, from the year 2022, to determine what kind of function they come from. The characteristics studied are: the average monthly temperature it provides and the dew point which is also a temperature, both measured in degrees Celsius. Numerically, the measured data are different, but follow the parabolic trend in the geometric representation in the plan. The resulting equation can be used for future predictions.

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