# THE PROCESSING OF EXPERIMENTAL DATA FROM 2021 WITHIN THE ORADEA MUNICIPALITY

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RESEARCH ARTICLE

**Abstract**

*This paper contains measured data from the weather station, at the Faculty of Environmental Protection, from the town of Oradea, Romania, for the year 2021. We will determine the equation from which these come, to use them in future predictions. The mathematical method used is called adjusting and interpolating numerical data through a parabola.*

**Keywords**: *adjusting, interpolating, numerical data, relative humidity, sunshine duration*
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## INTRODUCTION

In this paper, we will use the annual data from the meteorological station of the Faculty of Environmental Protection, from the municipality of Oradea, Romania, for the year 2021, namely the relative humidity as a monthly average and the duration of sunshine as monthly amounts.

Different events such as humanity, natural, biologicals, meteorological, and so on can be represented by a functional link between an independent variable x and a dependent variable y. In the case of this research work. we will analyze the variable x-duration of sunshine depending on the relative humidity represented by the variable y. The measured numerical data will be processed by the statistical method of adjustment and interpolation through a parabola.

Initially we will determine the trend by which we can establish the variation function of these two measurements. The second stage consists in determining the parameters a, b, c, real numbers from the composition of the function (Blaga, P. & Mureșan, A. 1996).

All these results can be used for future predictions or approximations.

## MATERIAL AND METHOD

We will use the data measured at the Weather Station where we denote the continuous function f: [a.b] → R, f(x) = y. unknown function. The numerical data measured for the $x_i$ which represent sunshine duration for i = $\overline{1,12}$. are presented in Table 1. We will consider the dependent variable $y_i$ , i = $\overline{1,12}$, which represent the relative air humidity, are presented in Table 2.

Table 1

**Sunshine duration (effective duration) – monthly and annual amounts at Oradea Meteorological Station,**

| Luna/an | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2021 | 69.3 | 41.6 | 84.8 | 238.2 | 308.9 | 227.0 | 263.8 | 304.1 | 230.0 | 170.1 | 116.6 | 45.8 | 2100.2 |

Due to accidental errors of observation or measurement $y_i \neq f(x_i)$, for this reason the appeared adjustment, as a method of determining with a minimum error the law of variation.

In the first stage, we will determine the trend after the graphic representati of the data.

The trend can be approximated with the logarithm function, or parabolic function , we will choose the parabolic for adjustment. So, the parabolic trend is characterized by the function $y = f(x;a,b,c) = a \cdot x^2 + b \cdot x + c$, a,b,c, real numbers, unknown.

Table 2

**Monthly and annual average of the relative air humidity at the Oradea Meteorological Station,**

| Luna/an | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2021 | 0.89 | 0.87 | 0.85 | 0.7 | 0.67 | 0.74 | 0.72 | 0.65 | 0.67 | 0.69 | 0.78 | 0.89 | 0.76 |

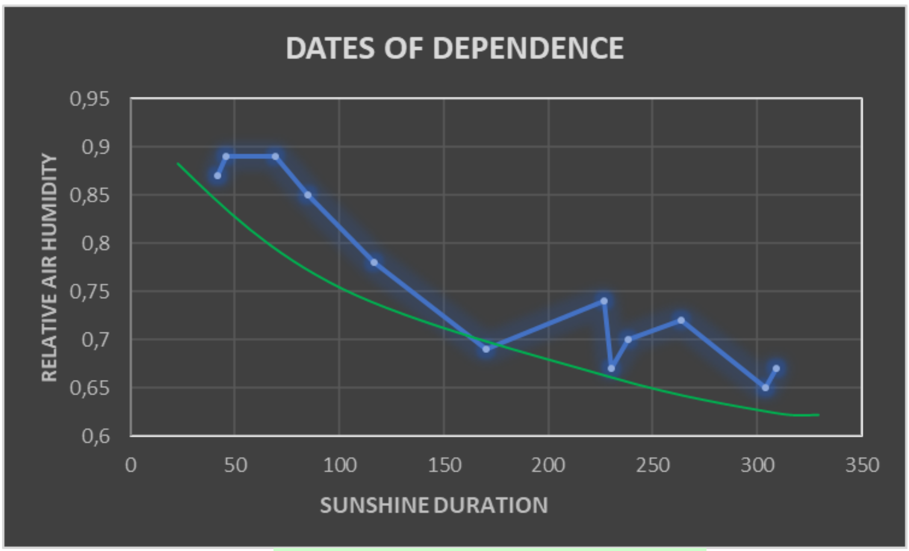


Figure 1 **Establishing the parabolic trend**

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 :

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

After replacement we will get:

$$\begin{cases} 67665{,}37663 \cdot a + 253{,}56518 \cdot b + c = 0{,}69552 \\ 57590{,}75959 \cdot a + 227{,}12408 \cdot b + c = 0{,}71537 \\ 39750{,}5 \cdot a + 175{,}0167 \cdot b + c - 0{,}76 \end{cases}$$

given the data in the Table 3.

Table 3

**Method calculations,**

| | $x_i$ | $y_i$ | $x_i^2$ | $x_i^3$ | $x_i^4$ | $x_i \cdot y_i$ | $x_i^2 \cdot y_i$ |
|---|---|---|---|---|---|---|---|
| | 69.3 | 0.89 | 4802.49 | 332812.557 | 23063910.2 | 61.677 | 4274.2161 |
| | 41.6 | 0.87 | 1730.56 | 71991.296 | 2994837.914 | 36.192 | 1505.5872 |
| | 84.8 | 0.85 | 7191.04 | 609800.192 | 51711056.28 | 72.08 | 6112.384 |
| | 238.2 | 0.7 | 56739.24 | 13515286.97 | 3219341356 | 166.74 | 39717.468 |
| | 308.9 | 0.67 | 95419.21 | 29474993.97 | 9104825637 | 206.963 | 63930.8707 |
| | 227 | 0.74 | 51529 | 11697083 | 2655237841 | 167.98 | 38131.46 |
| | 263.8 | 0.72 | 69590.44 | 18357958.07 | 4842829339 | 189.936 | 50105.1168 |
| | 304.1 | 0.65 | 92476.81 | 28122197.92 | 8551960388 | 197.665 | 60109.9265 |
| | 230 | 0.67 | 52900 | 12167000 | 2798410000 | 154.1 | 35443 |
| | 170.1 | 0.69 | 28934.01 | 4921675.101 | 837176934.7 | 117.369 | 19964.4669 |
| | 116.6 | 0.78 | 13595.56 | 1585242.296 | 184839251.7 | 90.948 | 10604.5368 |
| | 45.8 | 0.89 | 2097.64 | 96071.912 | 4400093.57 | 40.762 | 1866.8996 |
| TOTAL | 2100.2 | 9.12 | 477006 | 120952113.284 | 32276790645.33 | 1502.412 | 331765.93260 |

After solving the system we obtained :

a =0.0000273692894014521

b = - 0.00179358730585396

c = 0.9651098398406

from $f(x;a,b,c) = a \cdot x^2 + b \cdot x + c = y$.

With this function we will calculate for the 12 distinct points marked with $x_i$ the relative humidity values $y_i$. The adjustment function can be useful to interpolate or extrapolate future numerical data.

The result obtained refers to finding the adjustment function and numerical interpolation for the already measured data. Therefor the parabolic curve has the equation represented in Table 4.

The function obtained for the parabolic trend approximates and adjusts the numerical data and comparisons can be made with the already existing data.

We present the graphic for this adjustment function, which corresponds to the value in Table 5. The representation of the quadratic function of fitting numerical data represents the branch of a parabola, as in the Figure 2.

Table 4

**Parabolic trend equation,**

$$0.0000273692894014521 \cdot x^2 - 0.00179358730585396 \cdot x + 0.9651098398406 = y$$

Table 5

**Parabolic trend adjustment results,**

| x | 41.6 | 45.8 | 69.3 | 84.8 | 116.6 | 170.1 | 227 | 230 | 238.2 | 263.8 | 304.1 | 308.9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| y=f(x) | 0.90 | 0.89 | 0.85 | 0.83 | 0.79 | 0.74 | 0.70 | 0.70 | 0.69 | 0.68 | 0.67 | 0.67 |

## RESULTS AND DISCUSSIONS

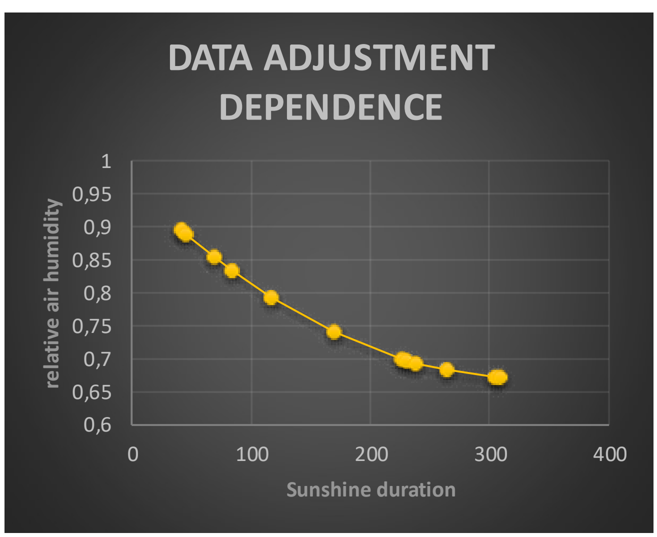


Figure 2 **Adjustment of numerical data through the parabolic trend**

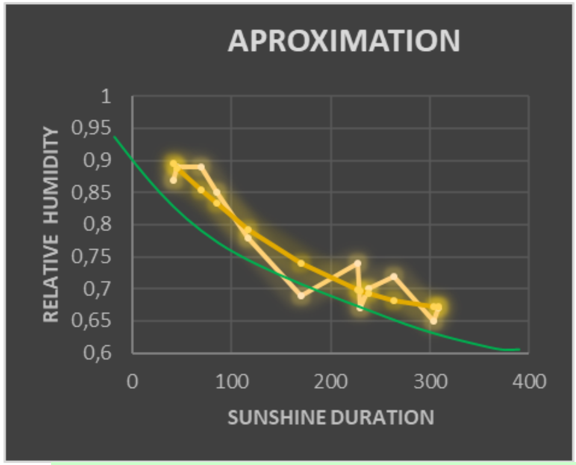

Figure 3 **Adjustment of numerical data, comparison**

## CONCLUSIONS

In conclusion, we determined the adjustment equation, using the parabolic trend, due to the initial representation of the data that can be approximated with the graph of a parabola. Now we can interpolate using this example function for an x = 80 which represents the duration of sunshine over a certain period of years to come and we will determine the relative humidity of the air by substituting the value of x into the expression of the adjustment function. We will get y = 0,84 = 84%, which represents the relative humidity of the air during that period.

For an extrapolation of the year 2022, let's assume that in December 2022 the collected data are x = 40, therefore after performing the calculations we get y = 90%. In the case of this research, it is also possible to calculate the opposite, if we know y, the value of x.

There are other methods of determining the adjustment function, which we will use in the following works for comparison. After we receive the data measured at the weather station for the current year, we will be able to check how useful this method is.

At the end of this research work we compared the graphs by overlay and obtained the following conclusion from Figure 3.

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