

Temperature vs Relative Humidity

Level: Intermediate | Subject: Geography and Mathematics

Duration: 50-min | Type: Classroom activity

LEARNING GOALS:

To determine the relationship between temperature and humidity using statistical analysis functions of TAHMO weather stations in MS Excel spreadsheets

MATERIALS:

- A computer with access to internet and MS Excel
- Access to school2school.net to download hourly humidity and temperature data

METHODS: PART I – HAND CALCULATIONS :

- 1 Go to the school2school website and select one of the stations you prefer, or use data from your local station if applicable. Click on temperature and humidity icons to open the data. Check at several temperature and relative humidity values measured at different times. Ask the class what they notice.

Are the humidity values the same or different at different temperatures?

- 2 Now that the students have noted that the humidity changes with the temperature ask the students to give reasons as to what might be the cause of this scenario. By doing so you challenge them to think harder about this particular topic and also you are able to know their level of awareness in this area. Their answers will create the hypothesis to our activity. The correct hypothesis is that humidity is inversely proportional to the temperature.

Hypothesis - Temperature increases humidity decreases and the inverse is also true.

- 3 To test the hypothesis you need the humidity and temperature data and therefore tell your students to collect and record several values of the two parameters, preferably in an excel spreadsheet with data in two different columns and name them.

Activity -> Student Worksheet

In the student handout, instructions are given for creating a table of data, plotting the data by hand, and calculating the correlation coefficient by hand (use of calculator are encouraged). These hand plots will be verified and compared with Excel plots in the following steps. First, here are a few discussion questions:

Q1: In our hand calculations, we only included 10 data points. When we plot all of the data points using Excel, do we expect it to show similar trends?

A1: Yes, because the 10 data points we used are a subset of the total data. We do expect the trends to be similar but not exact.

Q2: What are some advantages of making the plots and calculation by hand first before using Excel?

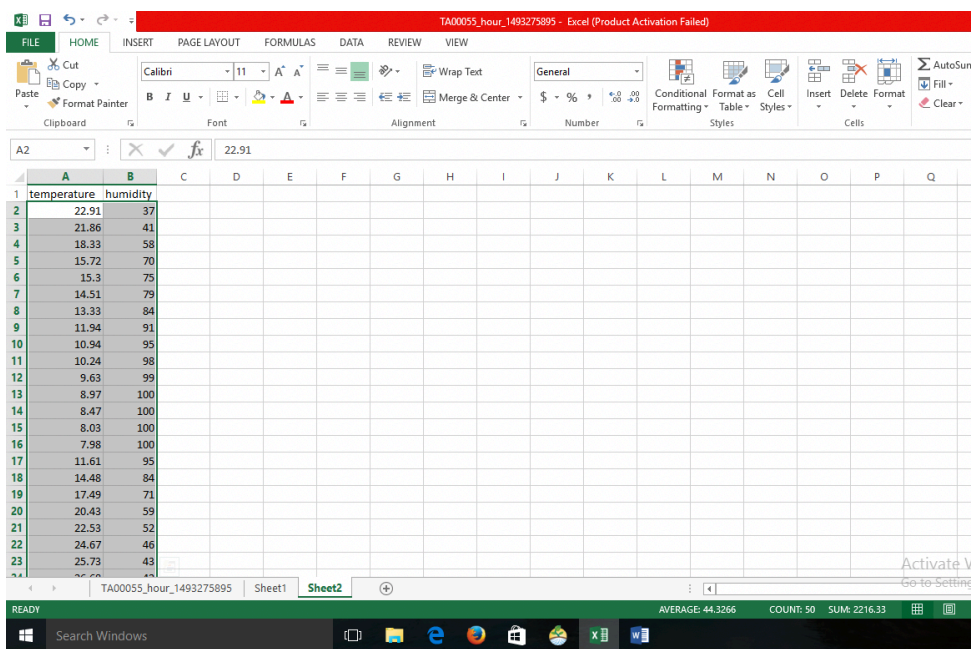
A2: To better understand the process if we do the plots and calculations ourselves, that way when Excel gives us an answer we can understand and interpret it correctly.

METHODS: PART II - EXCEL:

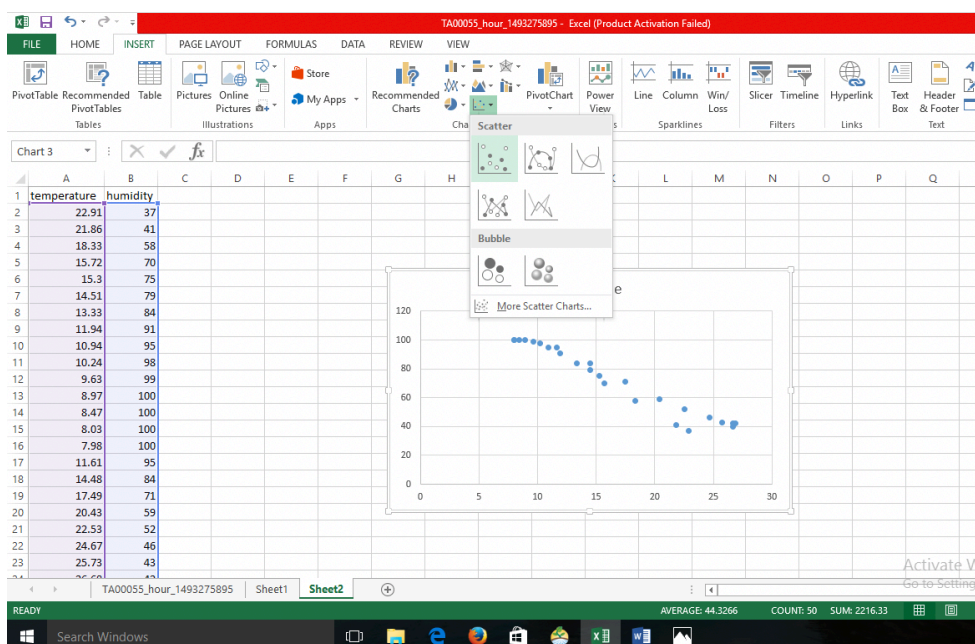
Visualize Data

Now that the students have a better understanding of the correlation coefficient and know how to calculate it, we will duplicate this process using Excel. Using excel, plot the values you have on a chart (scatter plot). This chart makes it easier to see how one variable is affected as the other one changes. Screenshots and calculations are provided based on data from TA00055 and should be taken as references only. To accomplish this follow these steps:

- 1 Highlight both columns containing temperature and humidity.

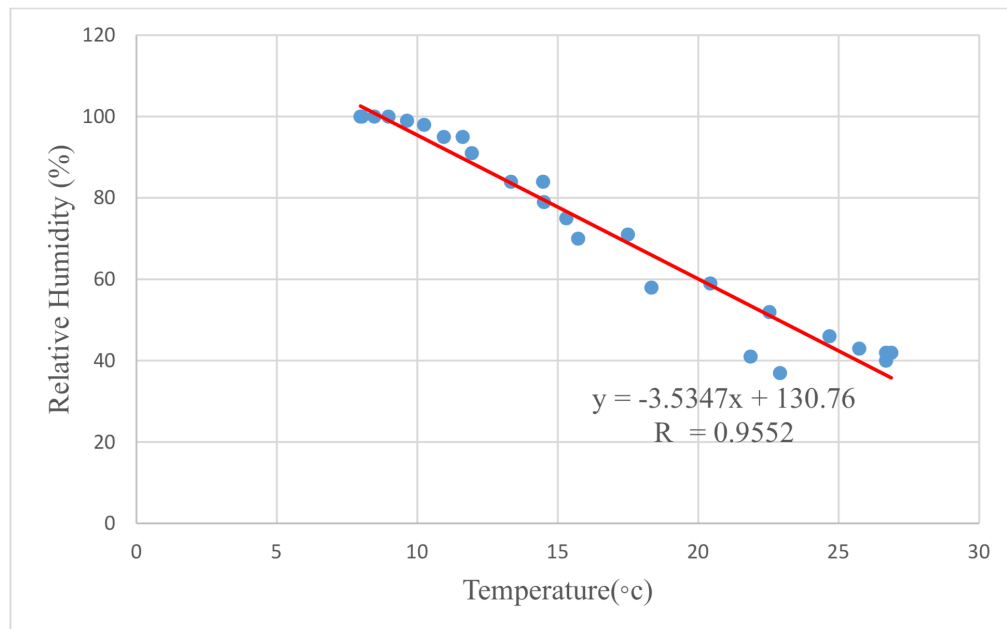


- 2 Open the insert tab on the main menu. Navigate to charts and select the scatter plots. A graph of the plotted data will be displayed.



METHODS: PART II - EXCEL:

- To see the trend, click an icon with a shape of a plus sign on the top right side of the chart and scroll down to trend line and select. A line will appear on the charts slanting on the direction of the change.



Compute Correlation Coefficient

To calculate the strength of the relationship between two parameters commonly referred to as correlation coefficient. The correlation coefficient determines the strength of the relationship between the two parameters. To accomplish this in Excel, follow these steps:

- Click on any cell in your sheet. Enter an equals “=” sign. Immediately behind the equals sign type the word “*corr*”, excel will immediately below bring an icon with the word “*correl*”. Double click on it. It will write “*correl*” inside your working cell (and just below it “**CORREL (array 1, array2)**”. Array is the data sets you want to perform the correlation. The number 1 and 2 indicates that you have two data sets that you want to perform the correlation.

	A	B	C	D	E	F
1	humidity	temperature				
2	37	22.91	=CORREL{			
3	41	21.86	CORREL(array1, array2)			
4	58	18.33				

METHODS: PART II - EXCEL:

- 2 So to perform the correlation click on **“correl”**. Inside your working cell, highlight your first column and insert a comma “,”.

	A	B	C	D	E	F
1	humidity	temperature				
2	37	22.91	=CORREL(A2:A26			
3	41	21.86	CORREL(array1, array2)			
4	58	18.33				

- 3 Highlight the second column and close the bracket, then press enter. A correlation value should appear. That tells you the strength of the relationship between the parameters. Correlation coefficient for this dataset is calculated to be -0.97736114. A correlative coefficient above 0.80 is said to be strong, a value below 0.5 is said to be very weak.

	A	B	C	D	E	F
1	humidity	temperature				
2	37	22.91	=CORREL(A2:A26,B2:B26)			
3	41	21.86				
4	58	18.33				

	A	B	C	D	E	F
1	humidity	temperature				
2	37	22.91	-0.97736			
3	41	21.86				
4	58	18.33				

DISCUSSION:

Q1: From the hand drawn plot and the Excel plots you created, what is the direction of the slope (Positive slope = / or negative slope + \)?

Q2: What does the slope direction tell you about the relationship between relative humidity and temperature?

Q3: We have identified a relationship from the above. The question you should ask now is, how did we mathematically measure the relationship?

Q4: Why is humidity inversely proportional to temperature?

A1: The slope is negative.

A2: A negative slope tells you that the two parameters are inversely proportional. This means that an increase in one parameter leads to a decrease of the other, and vice versa.

A3: Correlation coefficient. Using our spreadsheet we are able to define how strongly our parameters are related by use of the correlation coefficient (it is a term mostly used in statistics to show the strength of relationship between variables). From the analysis correlation coefficient is -0.97736114, which means they are strongly related but in the opposite direction, that is as one changes the other one also changes but in the opposite direction. The R-squared value is 0.9552 or 96% which indicates that 96% of humidity in the air is controlled by temperature.

A4: If the water vapor content stays the same and the temperature drops, the relative humidity increases. If the water vapor content stays the same and the temperature rises, the relative humidity decreases. This is because colder air doesn't require as much moisture to become saturated as warmer air.

Video Learning: [Why Does Humidity Feel Gross?](#)