How Hot or Cold Does It Really Feel?

By John F. Mahoney
Sidwell Friends School,
Washington D.C.

The National Weather Service created the **Heat Index** in 1979 in order to reflect the compounding effect of humidity on high temperatures, measuring how hot it actually feels. When the Heat Index is over 91, people are advised to exercise extreme caution. When it is above 103 the Weather Service warns of danger. When the Heat Index is over 124 there is extreme danger of heat stroke or sunstroke.

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The National Weather Service's formula for computing the Heat Index (hi) is:

$$hi = 16.923 + 0.185212t + 5.3791h - 0.100254th + 0.00941695t^2 + 0.00728898h^2 + 0.000345372t^2h - 8.14971 \times 10^{-4} t h^2 + 1.02102 \times 10^{-5} t^2 h^2 - 3.8646 \times 10^{-5} t^3 + 2.91583 \times 10^{-5} h^3 + 1.42721 \times 10^{-6} t^3 h + 1.97483 \times 10^{-7} th^3 - 2.18429 \times 10^{-8} t^3 h^2 + 8.43296 \times 10^{-10} t^2 h^3 - 4.81975 \times 10^{-11} t^3 h^3$$

where t is temperature and h is the relative humidity.

We can use the TI-92 Plus or the TI-89 to graph this function of two variables, z1 (x,y), with x being temperature and y being relative humidity. Both calculators have some new 3D graphing features. They can draw contour lines as in Figure 2. The darker lines relate to combinations of temperature and relative humidity which yield the same Heat Index. The number of contours is controlled by setting the Window appropriately (Figure 3.) The most interesting feature is harder to illustrate in print. Both calculators have a quick, easy to use animation feature for 3D graphs. One can animate the graph and view it from varieties of angles. Movement is controlled by the cursor key and four animation speeds are available. Students will love to use this feature!

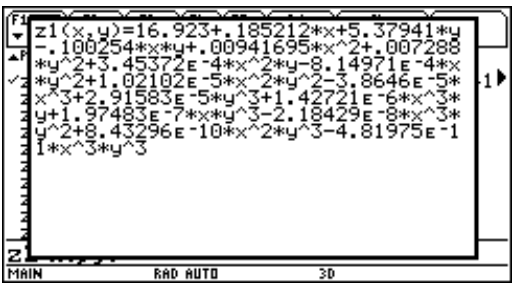

Figure 1

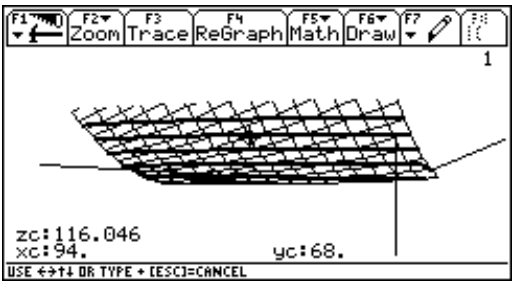

Figure 2

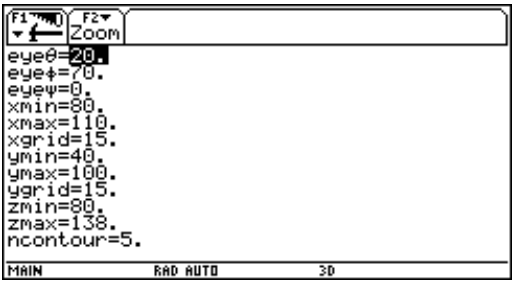

Figure 3

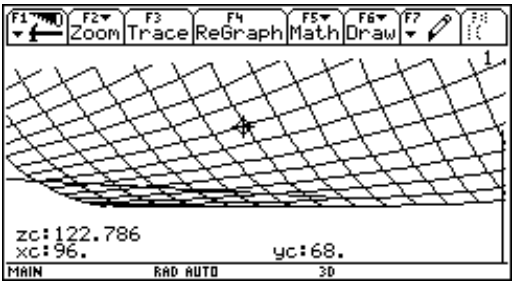

Figure 4

Tracing enables one to see values of the Heat Index for different values of temperature and relative humidity as shown in the wire frame view of Figure 4. The point represents a temperature of 96°F, relative humidity of 68%, giving a Heat Index of 122.8° F. ***Whew!***

While the Table function isn't available for 3D graphs, one can artificially get around this by making a series of functions based on the original as shown in Figure 5.

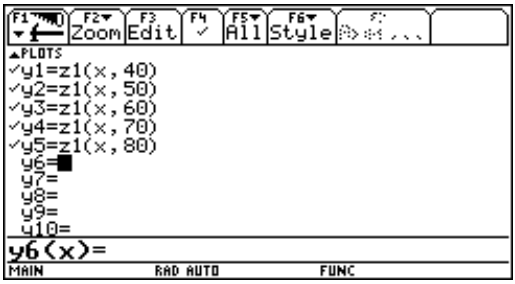

Figure 5

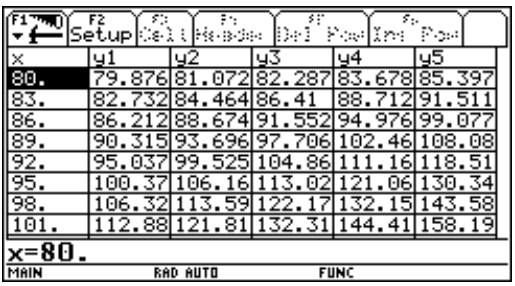

Figure 6

In the table (Figure 6) the left column gives various temperatures. The body of the table gives the Heat Index for various values of relative humidity.

The Wind Chill Factor is based on temperature, T, and Wind Speed, S, according to the formula:

$$W = 91.4 + (T - 91.4) * (0.478 + 0.301 \sqrt{S} - 0.02S)$$

It was developed in 1941 by Paul Siple and Charley Passel and is based on the rate of heat loss with various combinations of temperature and wind. I graphed it using contours and displaying a box based on the coordinate axes. The edges of the box are determined by xmin, xmax, etc.

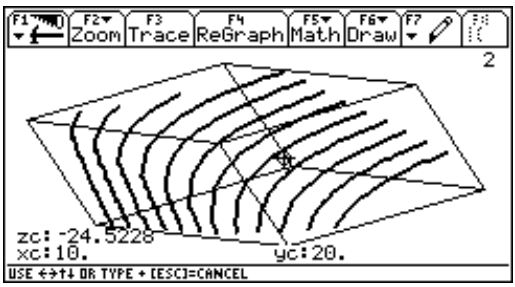

Figure 7

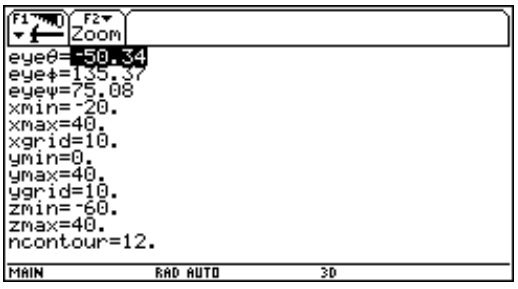

Figure 8

Each contour represents combinations of temperature and wind speed which yield the same Wind Chill Factor. The point identified in Figure 7 represents a condition of a temperature of 10° F and a wind speed of 20 mph with a Wind Chill Factor of –24.5°F. ***Brrrrrr!***

Readers are encouraged to view the appropriate pages on 3D graphing of the TI-92, TI-92 Plus Module and TI-89 manuals which are available on-line at:

education.ti.com/guides