What to Do with All Those Numbers?

Using computers to perform complex numerical calculations has become so commonplace that we frequently forget to curb our enthusiasm for “precision” and let the computer just take over. I have had so many GIS students who would report polygon areas to 0.0000001 acres, just because the computer could produce a value. Of course, 0.0000001 acres probably amounts to a teaspoon-full of soil! So, while the computer can calculate those infinitesimally small values, when we display numbers on a map or in a table, we need to be careful and mindful of the precision.

For this month’s Tips & Tricks, I’ll start with a shapefile containing polygons for the counties of Florida, and in ArcGIS Pro, add a field, SqMi (Square Miles) as a “Double”, with the default Number Format as shown in Figure 1. You can also use QGIS or any other GIS software package that can read/write shapefiles.

Then I’ll calculate the value using the Esri “Calculate Geometry” tool:

Notice that the values in the table (Figure 3a) are expressed out six significant digits, as specified by the default parameters when creating the field.

While you can change the number of digits displayed in the table by opening the “Fields View” of the table, double-clicking on the Number Format | Numeric cell to expose the ellipses (…) and then adjusting the Rounding | Decimal Places (to two), and Saving your changes, all this does is round the numbers as displayed in the table (Figure 3b) to your specified precision.

When I label the counties using the SqMi field, without respect to the values displayed in the table, I get label values, some of which are showing up to nine significant digits (Figure 4).

To put that into a real-world perspective, 0.000000001 miles would be four square inches! So, this brings up one of the re-occurring themes in this column … Never accept the defaults.” In this case, default also clearly demonstrates that it is up to the author of the map to determine the level of precision that is both necessary and appropriate for the data. However, as with everything GIS, there are multiple ways to produce the desired outcome.

I have had so many GIS students who would report polygon areas to 0.0000001 acres, just because the computer could produce a value. Of course, 0.0000001 acres probably amounts to a teaspoon-full of soil!
Figure 3a. ArcGIS Pro table showing calculated SqMi field displayed to default precision.

Figure 3b. ArcGIS Pro table showing calculated SqMi field displayed to customized precision.

Figure 4. Florida county map labeled by the SqMi field displays default label precision when the table values are customized.
**In ArcGIS Pro:**

**TIP #1 — Quick and Dirty** — One “quick and dirty” method to customize the precision displayed in the labels is to create the label as an Integer (i.e., a long) value. This method will round the very precise 32-bit floating value to an integer (i.e., no decimals). So, if you are making a very small-scale map and the numerical values are used as relative indicators, this might be a good solution.

1. If you have not created the SqMi field, just create a new field (SqMiInt; square miles, integer) as an integer field and then calculating the geometry as above, or
2. if you have already created the SqMi field, create the SqMiInt field and calculate SqMiInt = SqMi. In either case, you will get a whole number, i.e., an integer, rounded up (Figure 5), and those integers displayed on the map (Figure 6).

**TIP #2 — Methodical and Controlled** — While the quick and dirty technique might be sufficient for some small-scale maps, sometimes you might need to take total control of the precision. In a case where you want to report the values to 0.01 square miles (~278,000 square feet, or ~6.4 acres), you need to use the computer precision but in moderation. Once again, in ArcGIS Pro, you need to use the “Round” function, but this time, not in the table, but in the label.

As an example, to display labels with two-digits past the decimal:

1. Label using the SqMi field; it does not matter if you adjusted the table display or not,
2. Right-click on the layer in the Contents pane,
3. Navigate to the Label Properties … to open the Label dialog window,
4. Using the Arcade language and the Round() function, enter a custom expression in the Expression window where two is the number of digits past the decimal that you want to display (Figure 7). In this case, I wanted to display the county area to 0.01 square miles:

   The resulting map (Figure 8) shows two significant digits as labels which result from the expression in Figure 7.

---

**Figure 5.** Table showing the SqMiInt field as an integer value.

**Figure 6.** Map of the counties using the SqMiInt field for labels.
In QGIS (3.32.2-Lima):

Tip #3 — Labels in QGIS - As with ArcGIS Pro, it should not be surprising that by default, QGIS will also display the nine-digit precision in the SqMi field (Figure 9). (Note: Set the field to use for labels by double-clicking on the layer or open the Layer Properties dialog.)

1. Once a label field is selected,
2. Use the Labels option on the Layer Properties dialog to change the attributes (font, size, color, precision, etc.) of the labels. Here I changed the color to red, size to 12 points, and style to bold,
3. Check the “Formatted numbers” option (on the bottom of the dialog box), and
4. Set the Decimal places to two (Figure 10.)
The resulting map (Figure 11) displays the customized labels.

Figure 10. Once a label field is specified in the Display options, use the Label dialog box to customize the displayed values.

Figure 11. QGIS map showing customized SqMi field value labels.

For general GIS Tips & Tricks send you questions, comments, and tips to: GISTT@ASPRS.org

Al Karlin, Ph.D., CMS-L, GISP is with Dewberry’s Geospatial and Technology Services group in Tampa, FL. As a senior geospatial scientist, Al works with all aspects of lidar, remote sensing, photogrammetry, and GIS-related projects.