How to Join Data and Cartographically Display Results in ArcGIS Pro

The instructions below can be used to join a table to a spatial layer. In order for the join (also known as a table join) to be successful, the spreadsheet and the spatial layer must contain a common field, such as county name, county ID code, ZIP code, or census geography ID (e.g., census tract, block group, or block). Once the table has been joined to the layer, the information from the table can be used in spatial analysis tools or to create a cartographic display.

Prepare the Spreadsheet

Excel spreadsheets, CSVs and TXT files can be added to ArcGIS Pro, and joined to spatial layers. Prior to adding your table, use the steps below to prepare it.

1. Ensure that the table has a common field to be used to join to the spatial layer. This could be a column that stores a county ID code, ZIP code, asset ID, or census geography. In order for the join to be successful, the values in the table and the spatial layer must match exactly. If possible, set up the common field for the join using a unique code or ID number.

Note: The join is case sensitive and looks for exact matches. Differences in case, apostrophes, and the presence of leading or trailing spaces can prevent features from joining (matching).

2. Format the table using the tips below:
    - Every column must have a header (field name) that appears on the first row, starts with a letter, and does not exceed 64 characters.
    - Field names also cannot contain spaces or special characters. Use underscores as a substitute for spaces.
    - Do not merge cells.
    - Table should contain field names and data only.
    - Ensure that numeric fields are formatted as numbers. Field names should be formatted as text.
    - If the table has multiple sheets, rename the sheets to help keep things clear and organized.
    - Excel file names cannot contain spaces or special characters when saving the table.
    - If you are not able to add the Excel sheet, you may need to install a driver from the Microsoft Download Center, or convert your Excel to a CSV. See Work with Microsoft Excel files in ArcGIS Pro for more information.

Perform a One-to-One Join using Add Join

Non-spatial tables can be joined to a spatial layer if there is a common field. See the Add Join help documentation got more information.

1. In ArcGIS Pro, open a new project or an existing project.

2. Add the non-spatial table.
    a. To connect Pro to data on your local machine or a shared drive, a folder connection must be created. Use **Add Folder** on the Insert tab of the ribbon to create a saved folder connection.

    b. On the ribbon, click the **Map** tab. Click **Add Data**, then **Data**. Navigate to the spreadsheet or table you wish to join. Select the spreadsheet and click **OK**.

   c. The table will be added to the Contents pane under Standalone Tables.
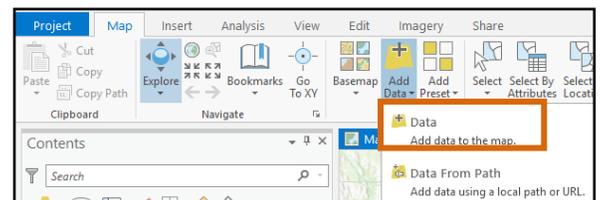
3. Open the table's **Attribute Table** to ensure all columns and rows were included.

4. Add the spatial layer that will be the base for your join (i.e., the layer that the table will be appended to).
   a. On the ribbon, click the **Map** tab.

   b. Click **Add Data**, then **Data**. Navigate to the spatial layer you wish to use. Select layer and click **OK**.

   c. The layer has been added to the Contents pane.
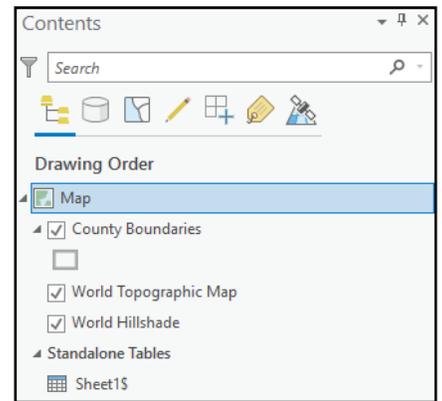
Note: To find Maryland boundary layers for joining, such as county, municipality, or ZIP code areas, check the MD iMAP boundaries category. Follow the instructions for **How to Add Web Services in ArcGIS Pro** to establish a connection to the MD iMAP server.
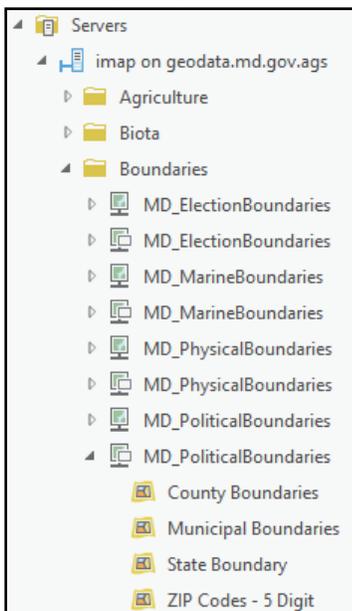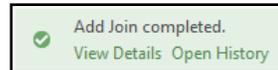
5. In the Contents pane, right-click the spatial layer to initiate the join. Select **Join and Relates** > **Add Join**.
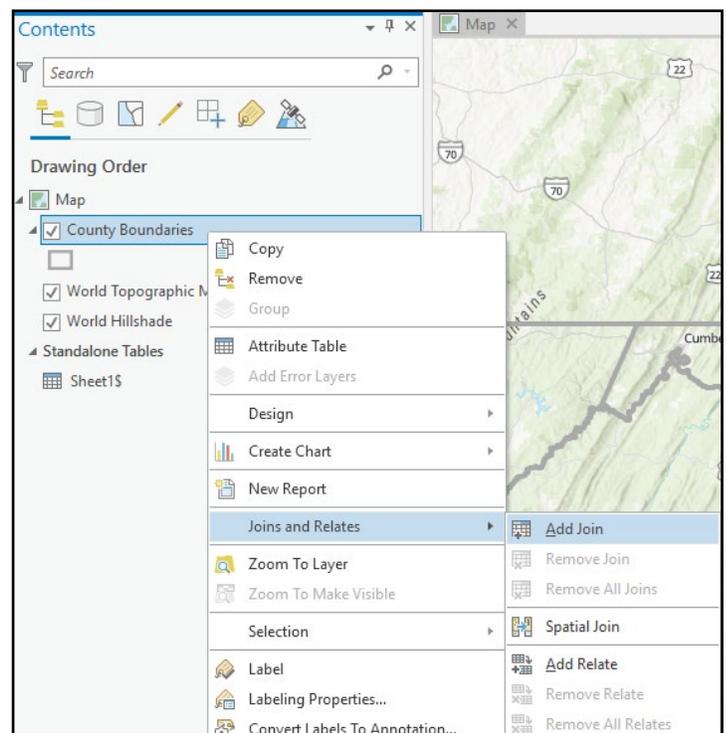
6. In the Add Join Geoprocessing pane, fill out the parameters:
   a. **Layer Name or Table View**: Spatial layer
   b. **Input Join Field**: Common field from the spatial layer
   c. **Join Table**: Non-Spatial table to join to the spatial layer
   d. **Output Join Field**: Common field from the table
   e. **Keep All Target Features**: This is the default, and will keep all features even if they do not match. If this is unchecked, only features that have found a match in the non-spatial table will be included.
   f. Click **Run**.
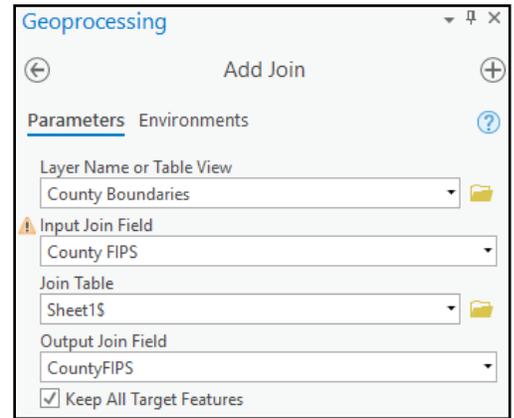
7. The progress bar will update to **Add Join completed** once the join has been created.

8. Inspect the attribute table of the spatial layer.
   a. In the Contents pane, right-click the spatial layer and select **Attribute Table**.
   b. If you scroll to the right in the attribute table, you should see the fields that have been joined from your non-spatial table.
   c. Ensure that all features have been included as expected. If you opted to Keep All Target Features you should see all the features from the original file. Those that did not find a match in the non-spatial table will show null values for the fields appended from the non-spatial table.
   d. Ensure that all features have matched as expected. You can double-click one of the new fields (joined form the non-spatial table) to sort the table in order to check if all the features in the spatial layer have matched to a row in the non-spatial table. If some features have not matched, check for inconsistencies (e.g., leading or trailing spaces, apostrophes, spelling errors) in the common field used for joining.

County Boundaries ✕

Field: Add Calculate | Selection: Zoom To Switch Clear Delete Copy

GIS Object ID	County Name	MDOT SHA	County FIPS	County Number	Transportation	GIS Shape	County	CountyFIPS	January	February	March
	Garrett	6	23	11		Polygon	Garrett	23	6.7	6.8	6.4
2	Washington	6	43	21	1060	Polygon	Washington	43	5.3	5.5	5.3
3	Dorchester	1	19	9	5	Polygon	Dorchester	19	6.7	6.7	6.4
4	Worce...			23	2	Polygo...	W...				10.9
5	Frede...			10	24	Polygo...					4
6	Harford	4	25	12	11	Polygon	Harford	25	4.3	4.3	4.2
7	Baltimore	4	5	3	6	Polygon	Baltimore	5	6.6	6.4	6.4
8	Carroll	7	13	6	1	Polygon	Carroll	13	4	3.9	3.7
9	Cecil	2	15	7	21	Polygon	Cecil	15	5.4	5.4	5.2
10	Prince George's	3	33	16	3	Polygon	Prince George's	33	4.6	4.6	4.6
11	Montgomery	3	31	15	16	Polygon	Montgomery	31	3.6	3.6	3.6
12	Talbot	2	41	20	18	Polygon	Talbot	41	5	5	4.8
13	Queen Anne's	2	35	17	22	Polygon	Queen Anne's	35	4.3	4.2	4
14	St. Mary's	5	37	18	7	Polygon	St. Mary's	37	4.6	4.5	4.4
15	Caroline	2	11	5	12	Polygon	Caroline	11	5.2	5.1	4.7
16	Somerset	1	39	19	8	Polygon	Somerset	39	9.1	8.6	8.2
17	Wicomico	1	45	22	19	Polygon	Wicomico	45	7.2	7.1	6.4
18	Allegany	6	1	1	9	Polygon	Allegany	1	7	6.8	6.6

Fields from spatial layer   **Fields from non-spatial table**

## Save Joined Features as a New Layer (Optional)

Using the Add Join tool creates a temporary join that is stored in your ArcGIS Pro project. To use this joined layer in other maps or projects, save it as a new layer.

1. Right-click the spatial layer with the geography. Select **Data** > **Export Features**.

2. In the **Feature Class to Feature Class** Geoprocessing pane:
    a. **Input Features**: spatial layer
    b. **Output Location**: Browse to a location to save the new layer
    c. **Output Feature Class**: The name of the new layer.
    d. Click **Run**.

3. The new layer will automatically be added to the Contents pane.
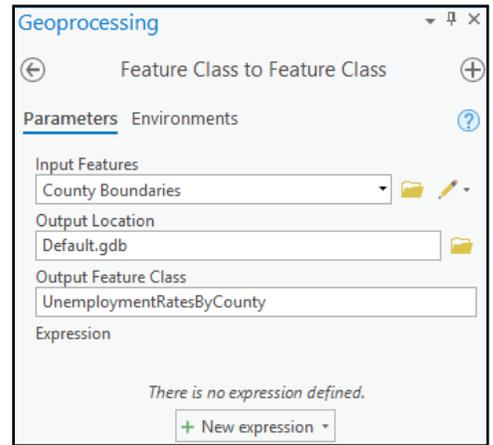

Display Data from the Joined Table

1. In the Contents pane, select the spatial layer. On the ribbon, click **Appearance**. Click the dropdown arrow below Symbology and select **Graduated Colors** or **Graduated Symbols**.

2. Considerations for cartographic display.
    a. **Graduated Colors** should only be used to show normalized values such as rates, percentages, or ratios. Examples include population per square mile, unemployment rate, percentage increase in home value, and births per 100,000.
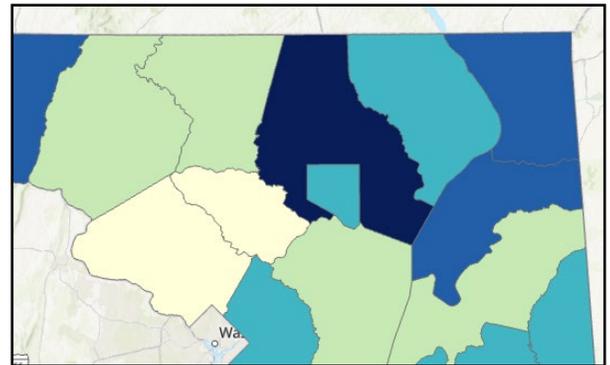
    b. If you are mapping raw data or counts (such as number of births, or number of cases), use the **Normalization** dropdown to select a field to normalize your data (such as total population), or switch to **Graduated Symbols** or **Proportional Symbols**.

    c. If you wish to compare several values for each feature, consider using the **Charts symbology** to use pie or bar charts to symbolize each feature.
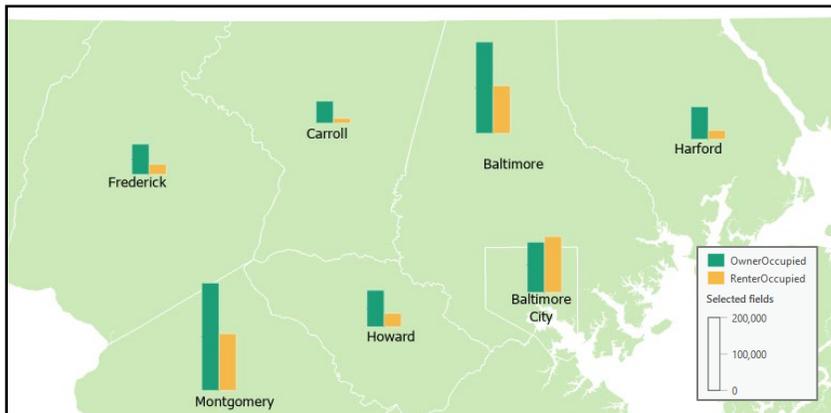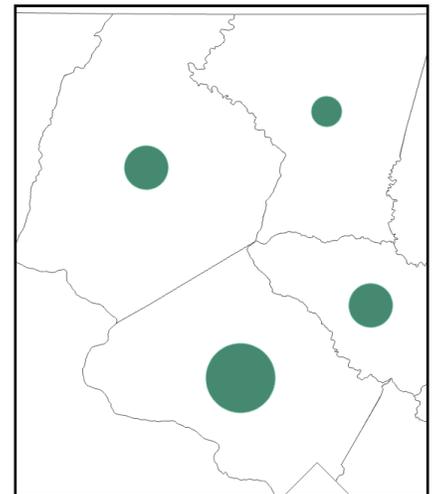
3. Use the Symbology pane to configure symbology for your layer.

    a. **Field**: Select the field to symbolize on.

    b. **Normalization** (optional): If mapping a count or other raw data, select a field to normalize the data. See above considerations.

    c. **Method**: Select the method of classification. (See the Common Methods of Classification section below to select an appropriate classification method.)

    d. **Classes**: Select the number of classes to display. For maximum visual impact, limit the number of classes to approximately 5.

    e. **Color scheme**: Select a color scheme to use. Use the gear wheel apply the color scheme to the outline as well as the fill.

    f. **Symbol**: Fill and outline colors can be changed by clicking the color patch that appears under Symbol. To modify the outline color for all symbol classes, go to **More** > **Format all symbols**.

    g. **Upper value**: Break values can be adjusted or rounded by clicking the break value as it appears under Upper value. Use the Histogram tab to adjust break values using the histogram (distribution of values). If any upper values are adjusted, the Method will change to Manual Interval.

    h. **Label**: The values that appear under Label can be modified to include units, remove unneeded zeros, or express ranges. This will be reflected in the Contents pane and map legend. It is

        often helpful to the map audience to use ranges

   in the legend rather than ≤ upper value.
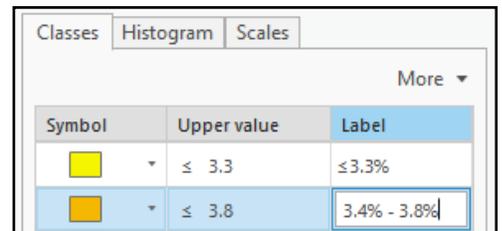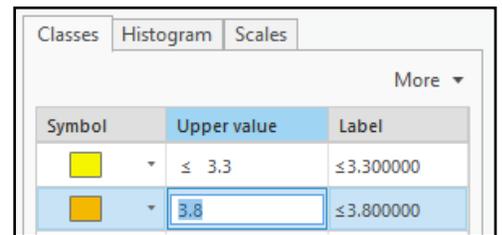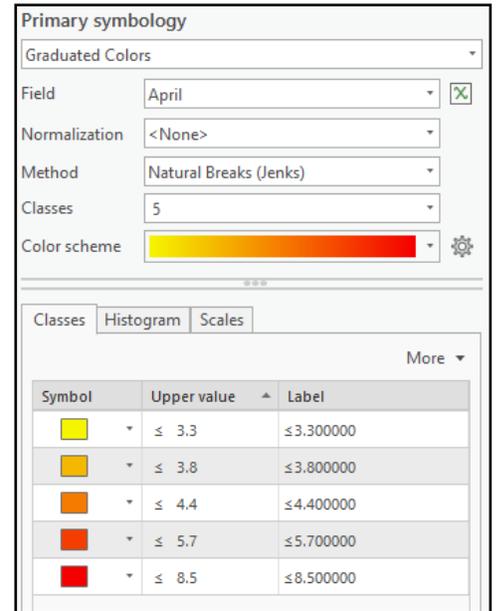
Common Methods of Classification

To visualize quantitative (numeric) data, we often break it into groups (also known as classes) and represent each group with a different color or symbol size. Classification refers to the method used to divide the data into groups. In the examples below, we are mapping by unemployment rate (percentage).

Natural Breaks

The Jenks algorithm is used to divide features into classes based on 'natural' groupings and gaps in the data values. To view the data distribution, use the Histogram tab in the symbology pane.
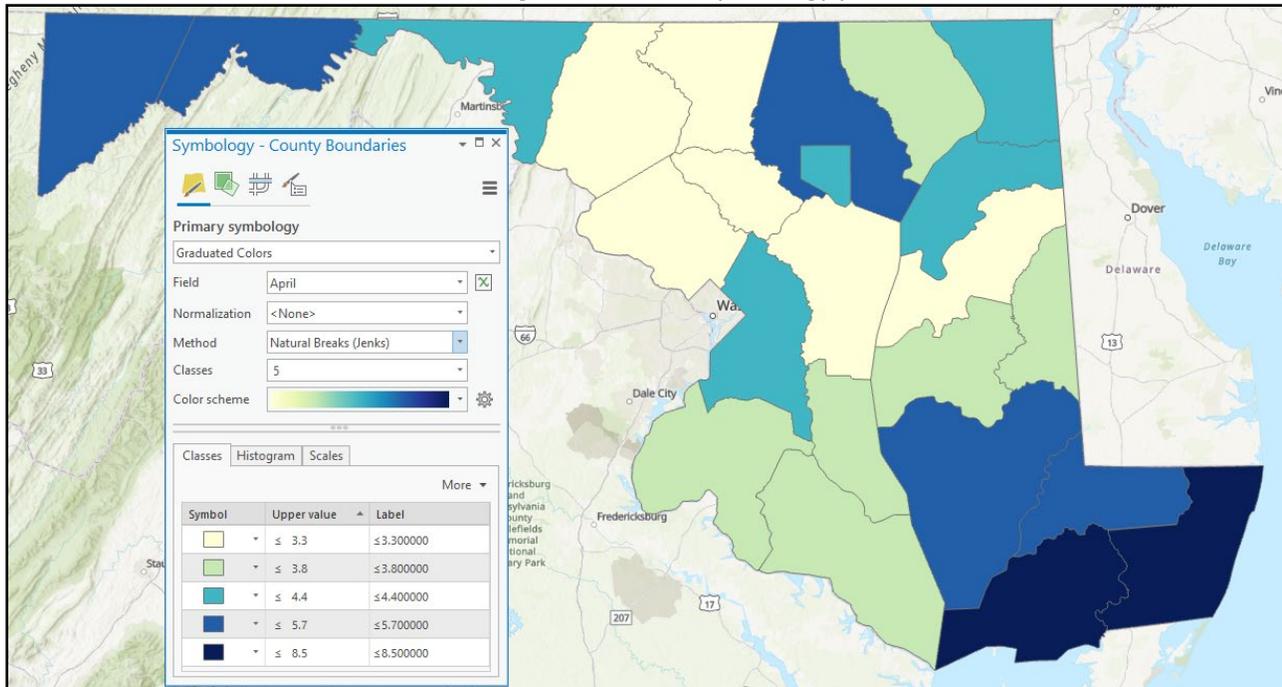

Quantile

An equal number of features are assigned to each class. This may result in features with very similar values being in different classes, or features with very different values being put into the same class.
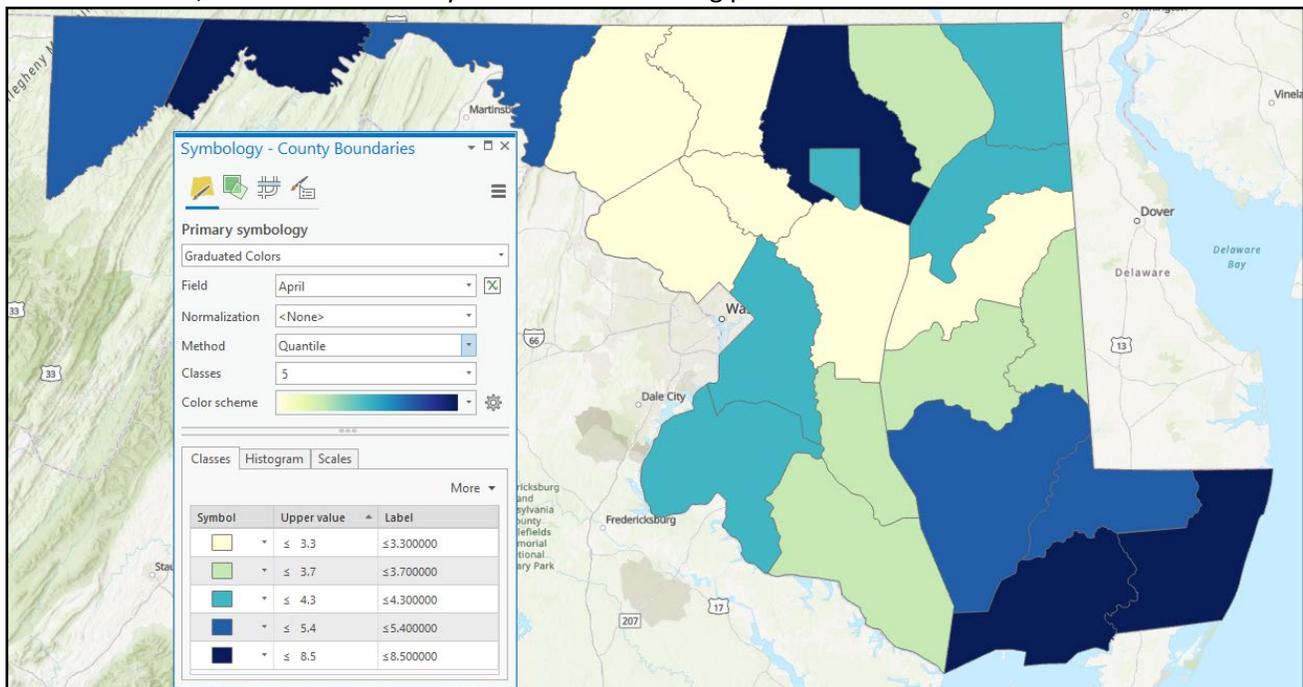
Equal interval

The minimum and maximum values and the desired number of classes are used to determine the class width. Class widths (intervals) are equal. In this example, each interval is ~1.87. In this classification method, there may be some classes that do not contain any features.
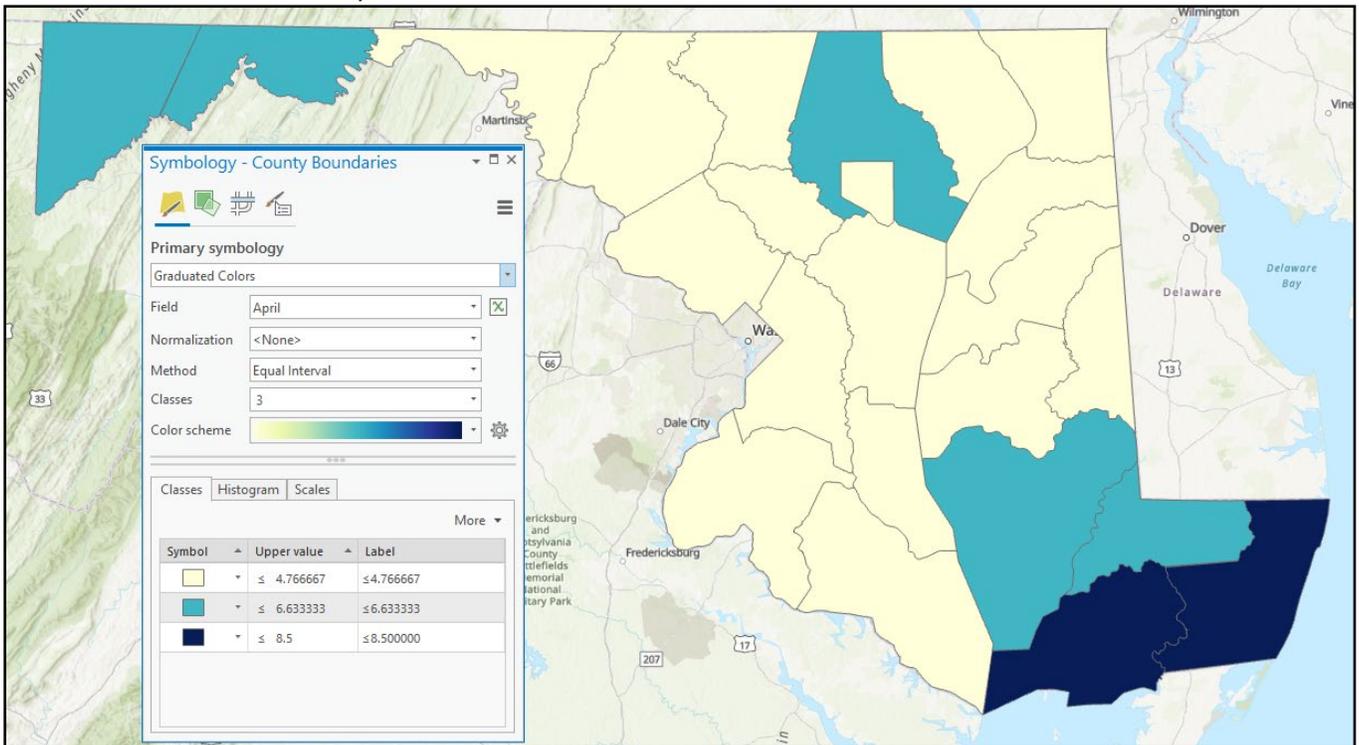
Defined Interval

The user determines the interval value. Class widths are equal. In the example below, unemployment rates are being mapped for each county. The interval size has been set to 1, so that each class represents an interval of 1%.
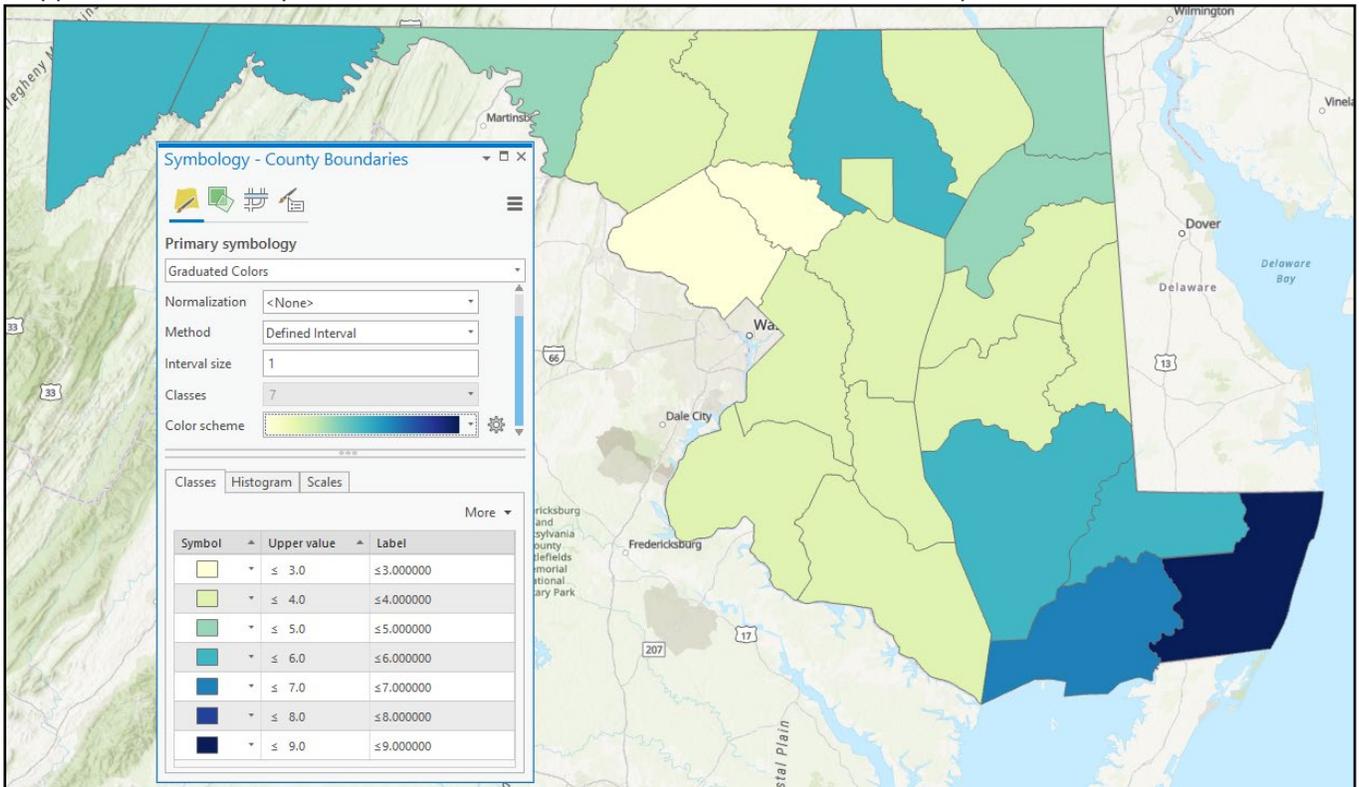
Manual

The user has full control over how the values are grouped into classes. Use manual classification when you want to change the break values or define your own classes. This can be helpful if you wish to round your break values.

- Under the **Classes** tab, double-click a value under Upper value to edit.
- Press the **Tab** key to apply the change.