

Module4 Lab

From Data to Design

In this lab, students will make four map layouts for the Africa Atlas to compare different thematic mapping techniques. This lab is for thematic mapping. Students should integrate map design knowledge such as creating balanced map layouts and neat map marginalia when making the maps.

Lab Objectives

- Explore the influence of symbolization methods (graduated symbol, proportional symbol, and dot density symbol) on map output and design using ArcGIS Pro.
- Create one map layout to demonstrate the assigned thematic mapping techniques.

Overall Lab Requirements

For this Lab, you will create and submit one map layout for the Africa Atlas. The one map layout include four maps. The first map will use graduated symbols to show the size of diamond mines. The second map will use pie charts to show the makeup of each country's electrical productions. The third one will use proportional symbol maps to show the 2000 population of each country in Africa. The fourth one will make a dot density map showing the distribution of Africa's population by country. You will import the four maps to make one final map layout for the Africa Atlas.

Students' final task will be to write a reflection that compares these techniques in the context of this lab.

- Include a written reflection (250+ words); use the following questions to guide your writing:
 - What were your design considerations in developing your four maps? Discuss the advantages and limitations of the different thematic mapping techniques that you used.
 - Submit this reflection as a text comment or in a separate .pdf document.

Map Requirements

- Create four maps using different thematic mapping techniques to symbolize your data.
- Create one map layout with scale bars, legends, and supplemental map text (e.g., map titles, legend titles) as appropriate.

Lab Instructions

1. Download the [Module4 Lab Data zipped file](#) . It contains:
 - a project (.aprx) file to be opened in ArcGIS Pro;

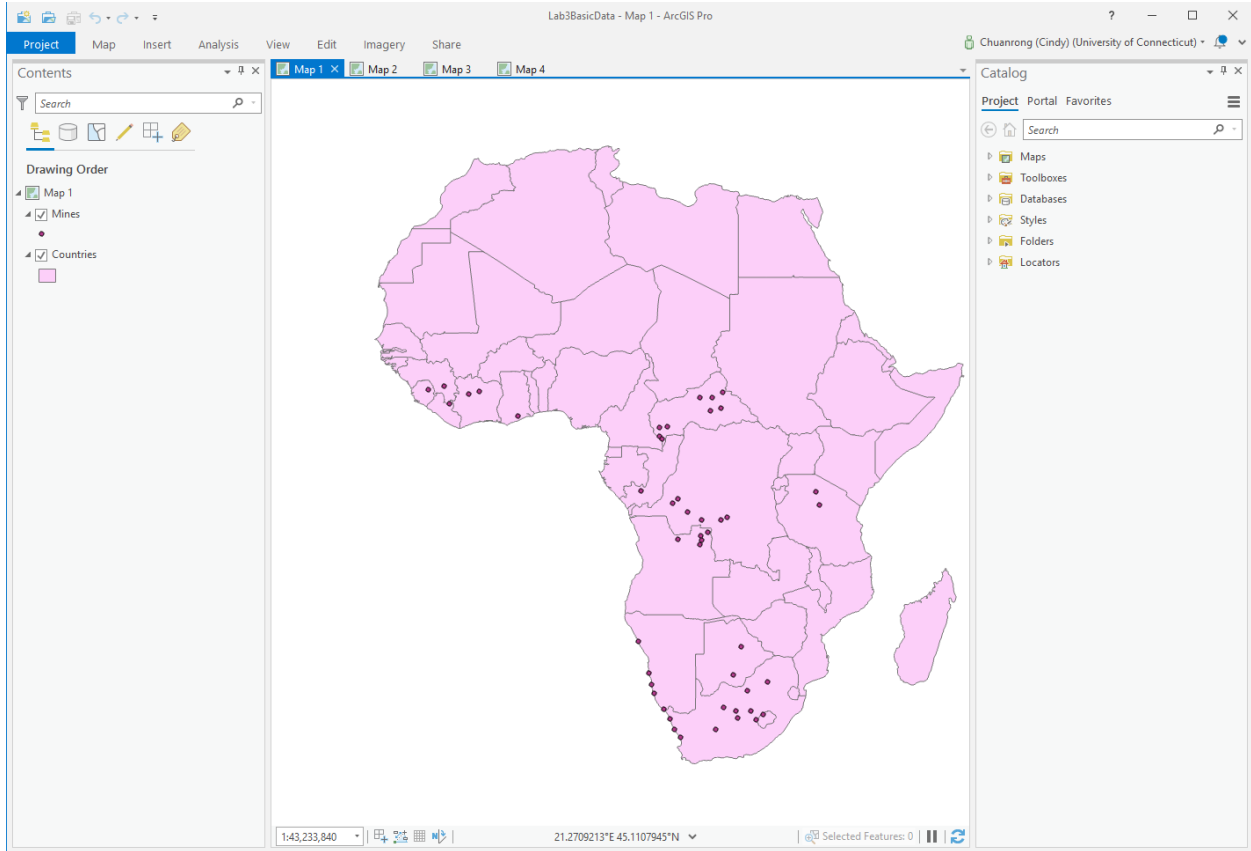
- a database that includes the spatial data needed to start this lab.
- 2. Extract the zipped folder, and double-click the blue (.aprx) file to open ArcGIS Pro.
 - You'll see the starting file, which includes different data for this lab. See the below guide for detailed instructions.

Submission Instructions

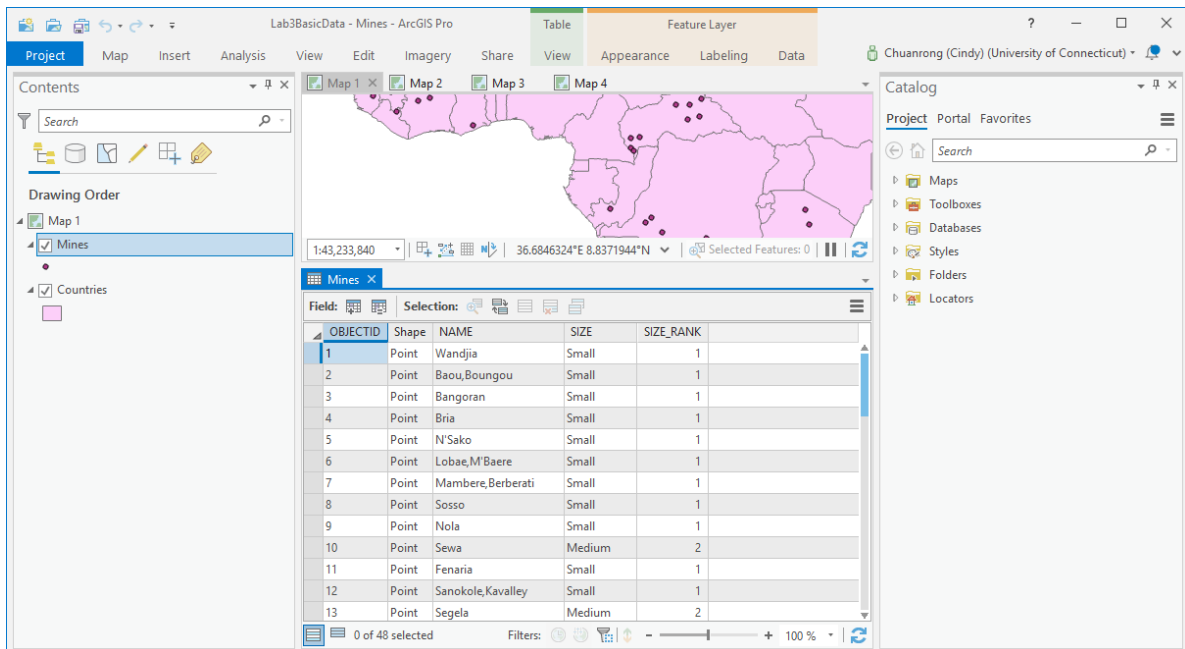
- Submit the final Map Layout as PDF—the Map Layout should be designed in a neat 8.5 x 11-inch layout using the naming conventions below. You may attach your statement about the maps as an additional .pdf document, or add the text as a comment with your assignment.
 - Map Layout—YourLastNameFirstName_Module4LabAfricaAtlas_Map.pdf
- Submit the PDF and your reflection statement to **Module4 Lab**.

Detailed Instructions for the Lab

- **Map1: Africa Mines**
1. Click “Module4LabData.aprx” to open your ArcGIS Pro project: this is your starting file in ArcGIS Pro: It contains four Maps for Africa: Map 1 will use graduated symbols to show the size of diamond mines. Map 2 will use pie charts to show the makeup of each country's electrical productions. Map 3 will use proportional symbol maps to show the 2000 population of each country in Africa. Map4 will make a dot density map showing the distribution of Africa’s population by country.

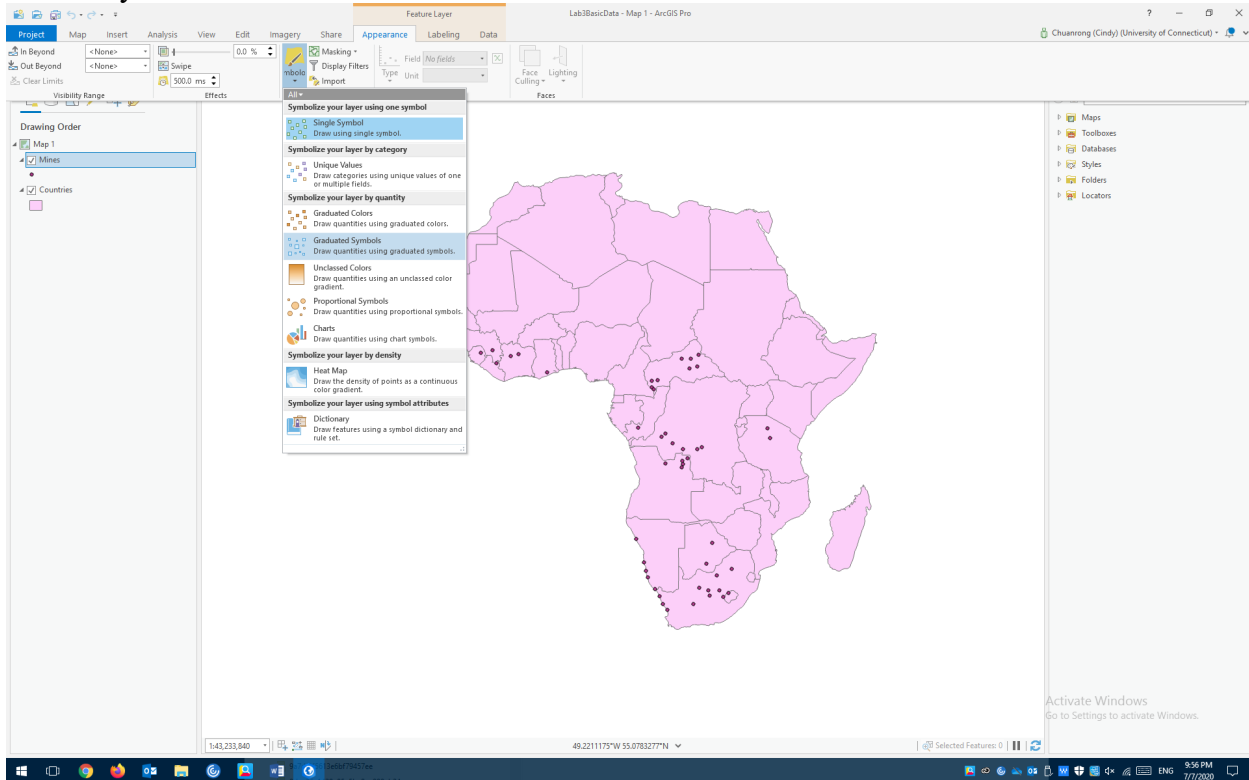


2. The Map 1 includes a Mine layer, which uses points to represent the locations of forty-eight diamond mines. Because all the point symbols are the same, you cannot tell anything about the size of each mine.
3. In the Contents Pane, right-click the Mines layer and click Open Attribute Table.

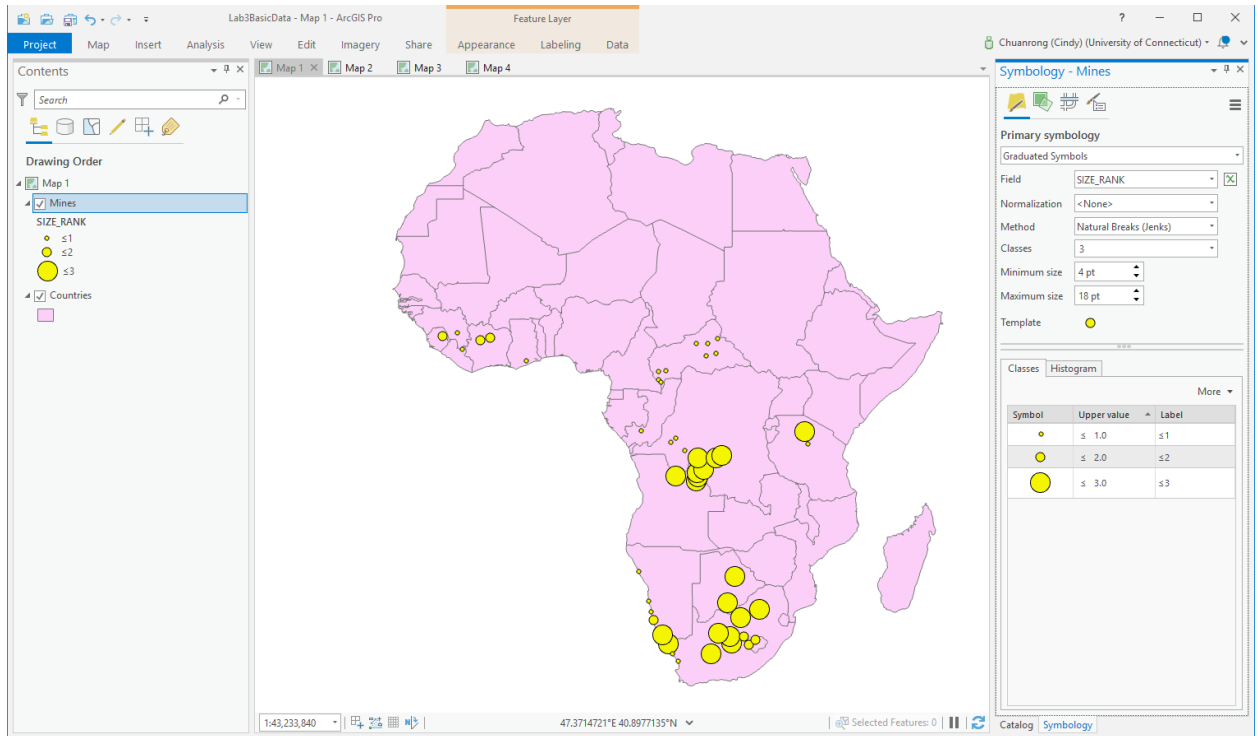



The layer attributes include the name of the mine, its size (small, medium, or large), and a SIZE_RANK field that translates the size values into numbers.

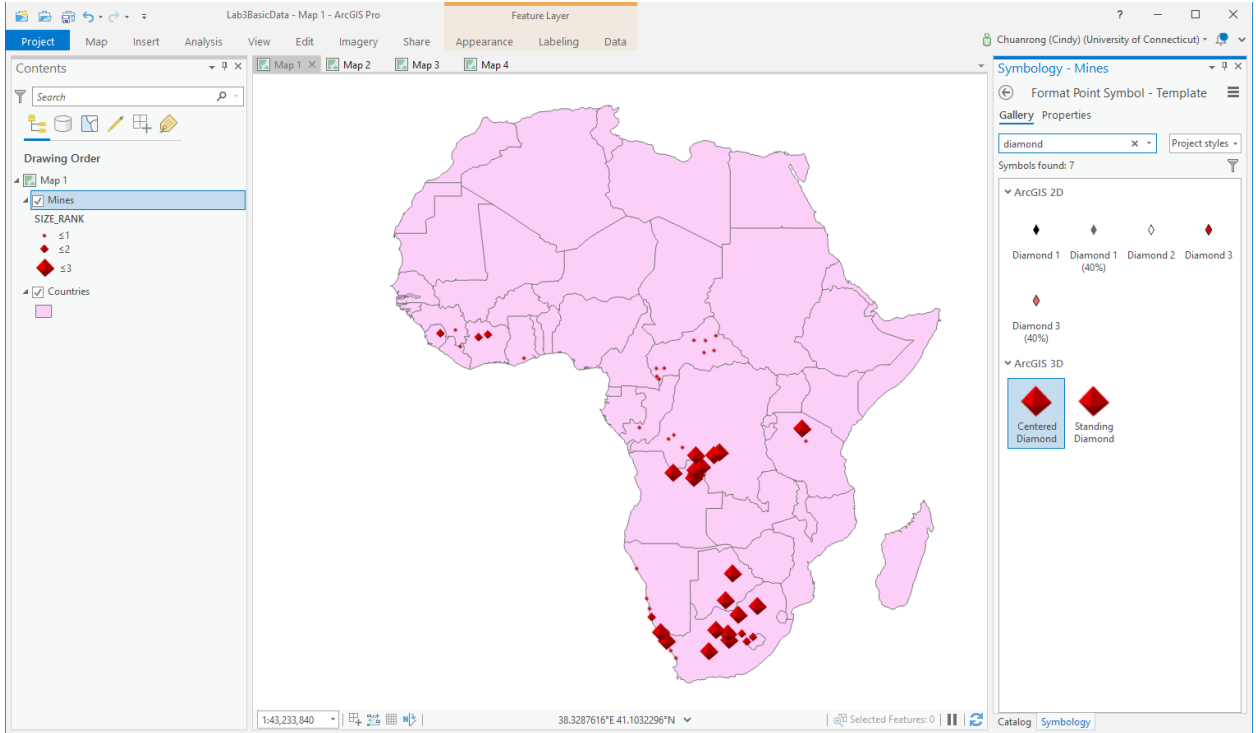
4. Close the attribute table.
5. Select the Mine layer in the Contents pane.
6. On the Appearance tab, in the Drawing group, click Symbology and click Graduated Symbols.



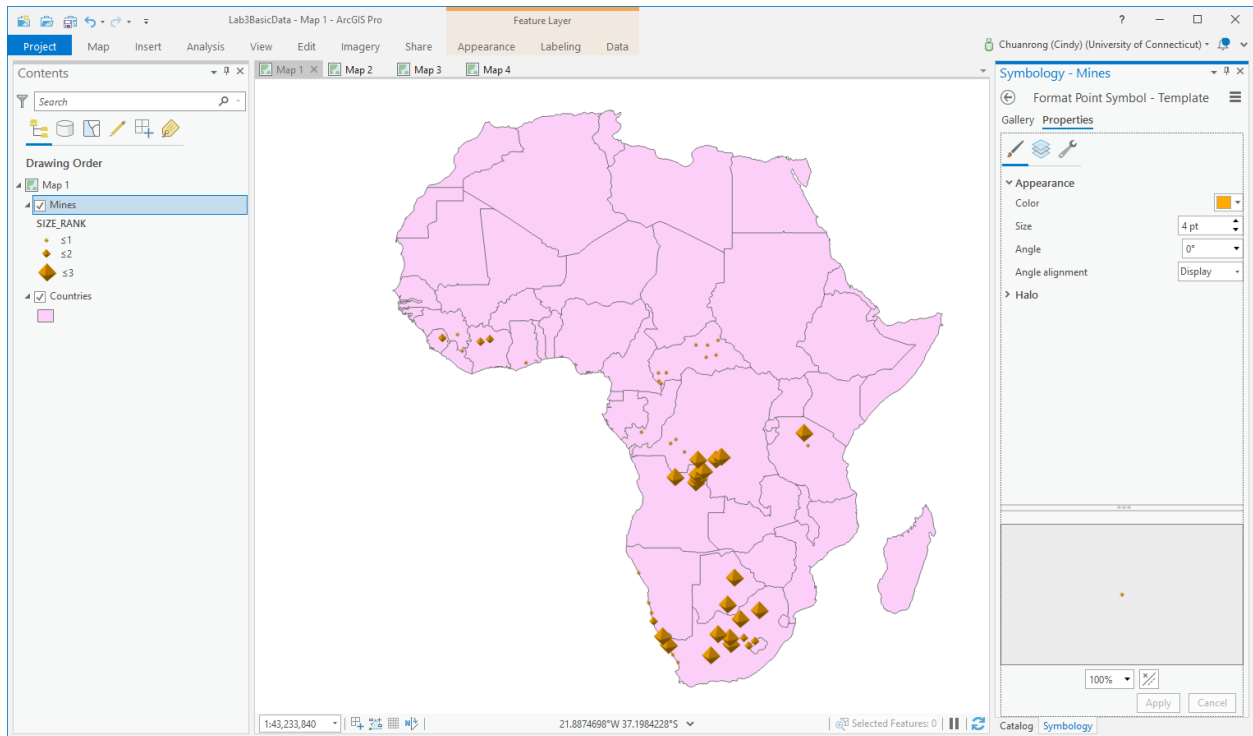
7. The Symbology pane appears.



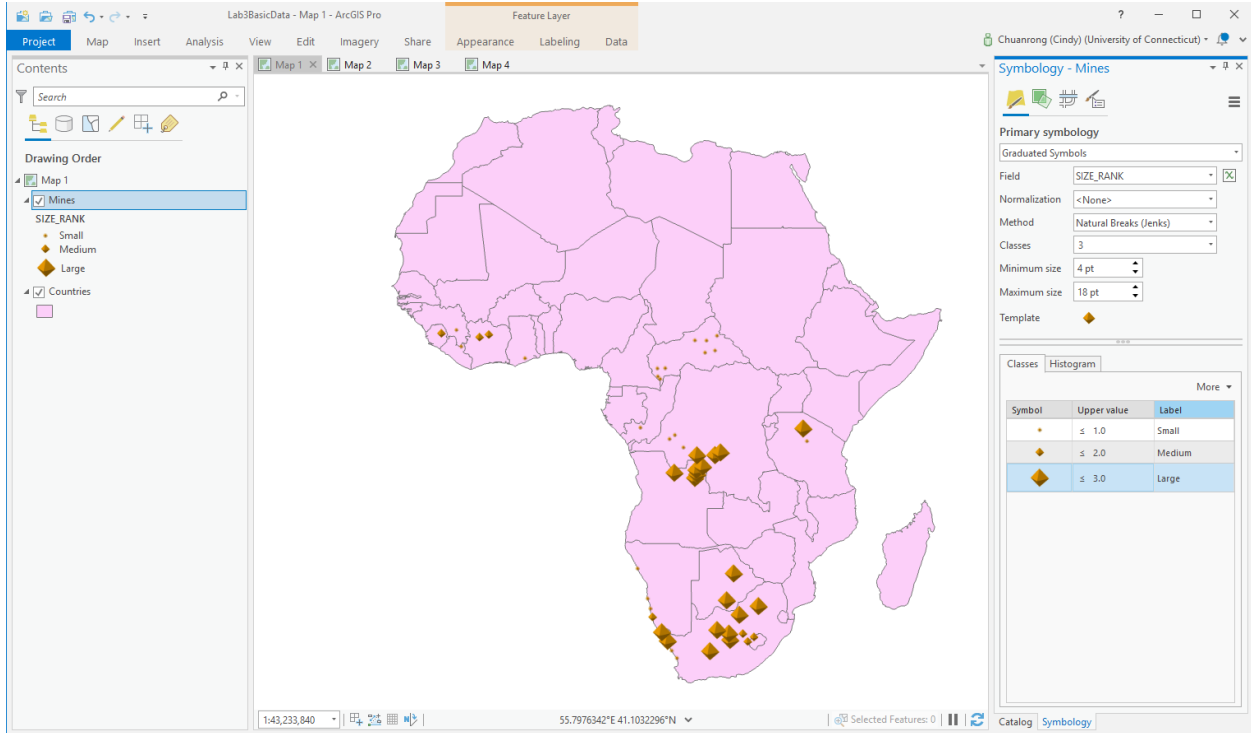
8. In the Symbology pane, on the Primary symbology tab , choose the numeric field for the data to be mapped, or write an expression. In this case, SIZE_RANK as the only numeric field in the table is chosen for the Field. In the symbol column, three symbols appear. You'll change them to a symbol that looks more like a diamond.
9. In the Template frame, click the point symbol to open the Format Point Symbol-Template. Type "diamond" to search symbols in the Gallery. Choose one diamond symbol.




10. Try to edit the symbol to your favorite symbol for the mine layer. Think carefully about the parameters you choose! For example, you can change the diamond color into gold as below:

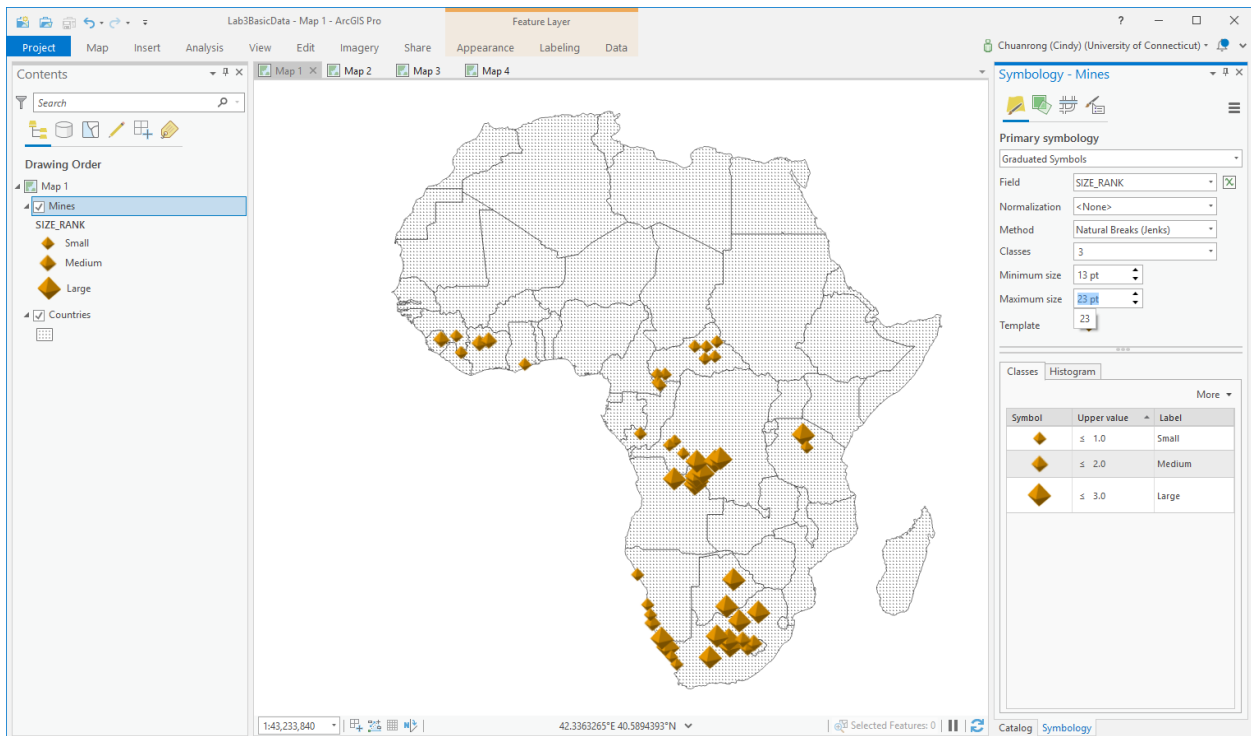


11. To edit a label, right-click the text in the Label cell and click Edit label.



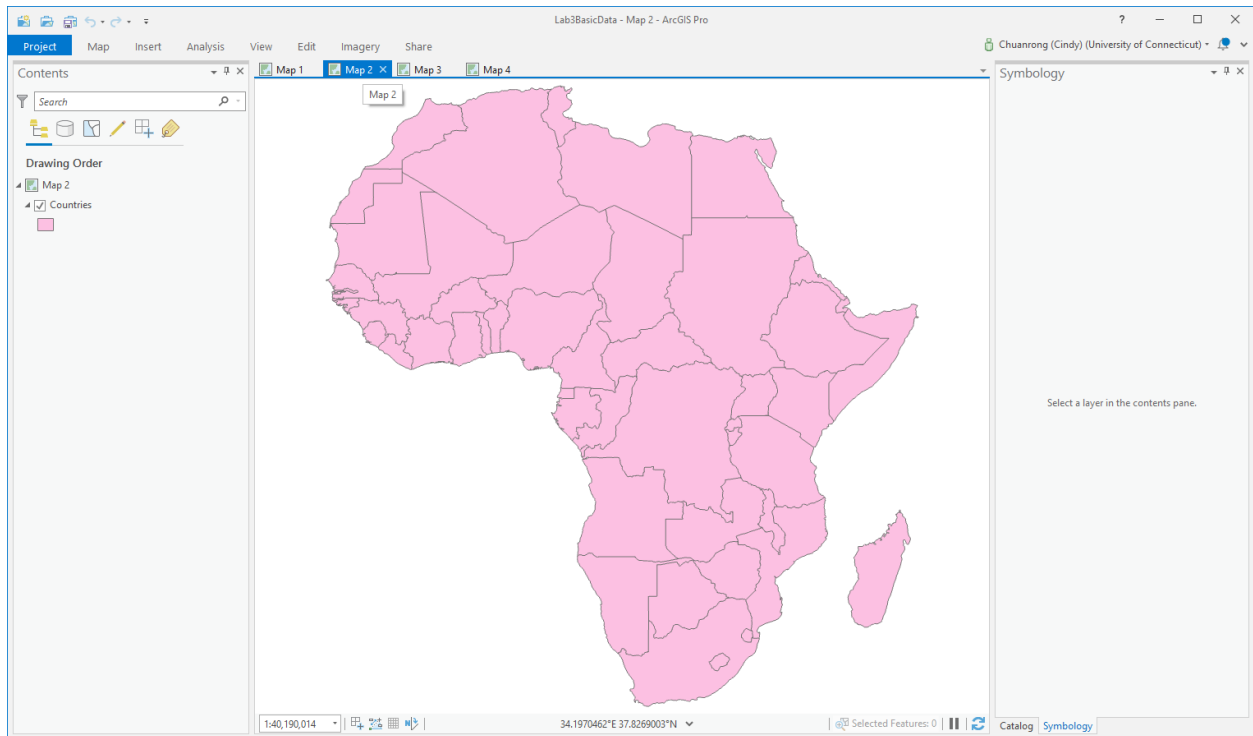
12. You can change the background color of the countries.

13. On the Quick Access Toolbar, click the Save button  to save the project.



- **Map 2 Africa Electric Power**



1. If necessary, click your saved “Module4LabData.aprx” to open your Module 4 Lab ArcGIS Pro project.
2. Click Map 2 to activate it.

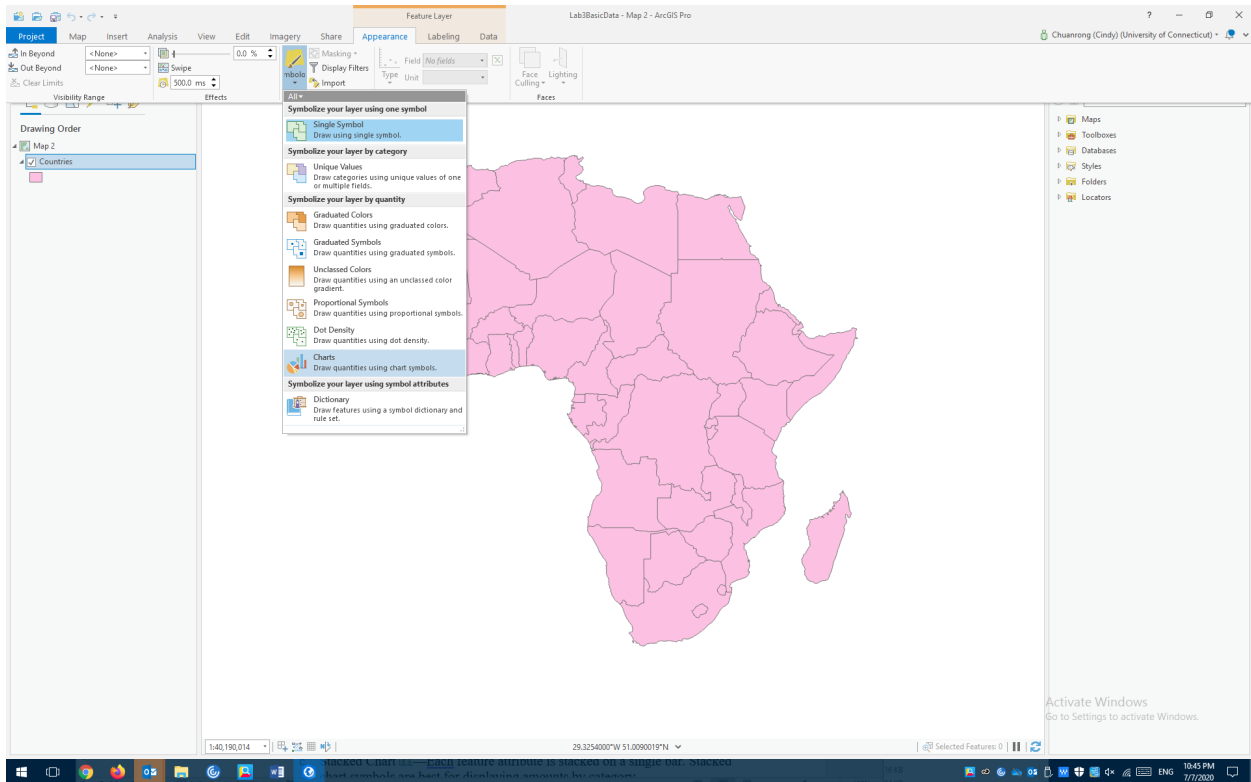



3. Right-click the Countries layer and click Open Attribute Table. Scroll all the way to the right.

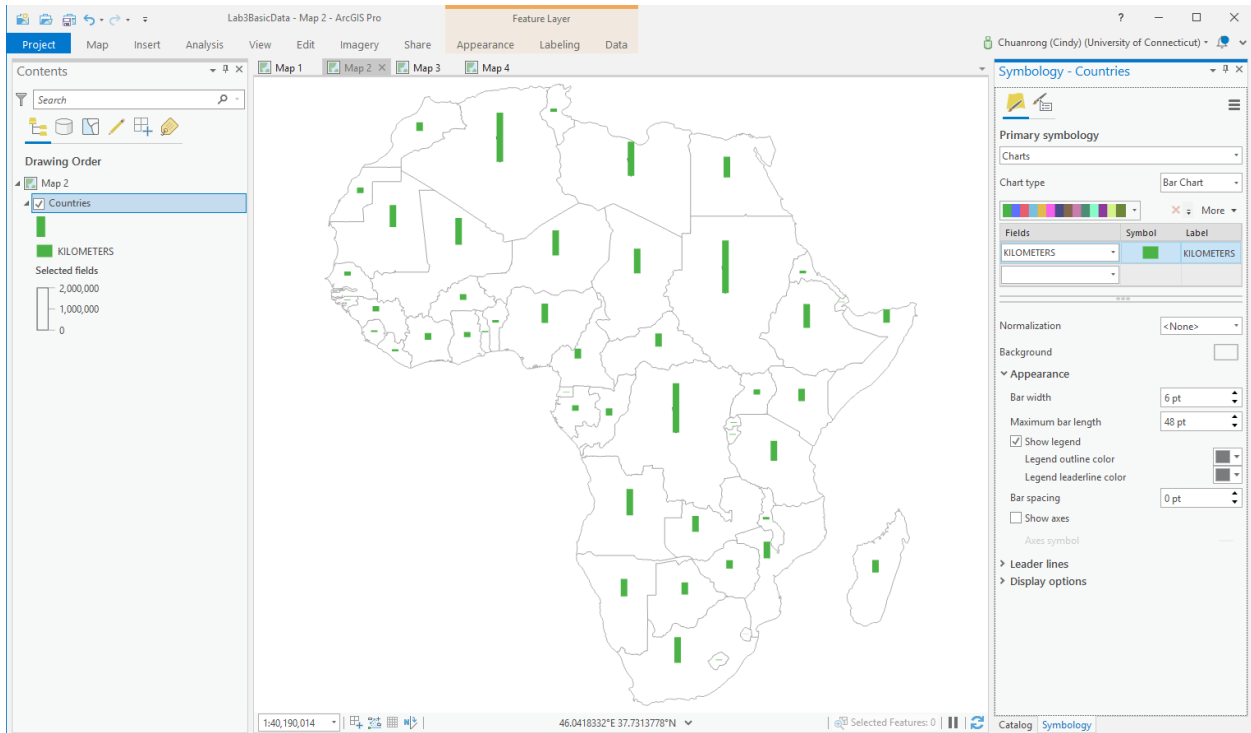
The screenshot displays the ArcGIS Pro interface. The main map shows a pink-shaded map of Africa. Below the map is a table with the following data:





ID	Shape	NAME	KILOMETERS	POP1998	POP1994	POP2000	POP1980	FOSSIL	HYDRO	OTHER	Shape_Length	Shape_Area
Polygon Algeria	2320972	27459230	24453010	30488943	18669010	99.77	0.23	0	70.776952	213.512502		
Polygon Benin	116515	5175394	4593000	6487990	3464000	100	0	0	17.168059	9.573214		
Polygon Botswana	580011	1446623	1217000	1700875	902000	100	0	0	34.051488	50.676405		
Polygon Burkina Faso	273719	10164690	8776001	11814948	6962000	66.44	35.56	0	27.209214	22.633484		
Polygon Burundi	272254	6011039	5299000	7374318	4114000	1.57	98.43	0	7.783915	2.212089		
Polygon Cent Af Rep	621499	3149545	2951000	4007031	2320000	19.05	80.95	0	42.471925	50.596675		
Polygon Chad	1168002	6308708	5537000	7296271	4477000	100	0	0	51.846358	107.293813		
Polygon Congo	345430	2318276	2208000	3112338	1630000	0.6	99.4	0	38.191944	27.975908		
Polygon Djibouti	21638	450751	409700	632718	300000	100	0	0	7.330362	1.777704		
Polygon Egypt	982910	56133430	51390000	66851491	40792000	78.72	21.28	0	53.523022	90.484511		
Polygon Eritrea	121941	3662271	3300000	4631792	2800400	100	0	0	23.52889	10.120875		
Polygon Ethiopia	1132328	53142970	53400000	75512339	37717010	7.35	89.34	3.31	46.966864	92.721298		
Polygon Gambia	10678	936026	848000	1187693	634000	100	0	0	10.861138	0.894459		
Polygon Ghana	239981	16698090	14425000	20289781	10740000	0.1	99.9	0	23.183493	19.611297		
Polygon Guinea	246077	6242007	5547000	7412033	4461000	63.55	36.45	0	32.065958	20.23947		
Polygon Ivory Coast	322216	13498860	11713000	18533740	8194001	35.71	64.29	0	32.089139	26.343497		
Polygon Kenya	604430	16837320	13779000	24407016	12637000	0.97	89.74	0.00	55.144471	47.501762		



- In addition to the name, size, and population attributes, three fields show what percentage of each country's electrical production comes from fossil fuels, hydro-electricity, and other means. You'll use pie charts to represent this data.
4. Close the table.
 5. Click the Countries layer in the Contents pane.
 6. Under Feature Layer, on the Appearance tab, in the Drawing group, click the Symbology drop-down arrow .
 7. Under Symbolize your layer by quantity, click Charts .




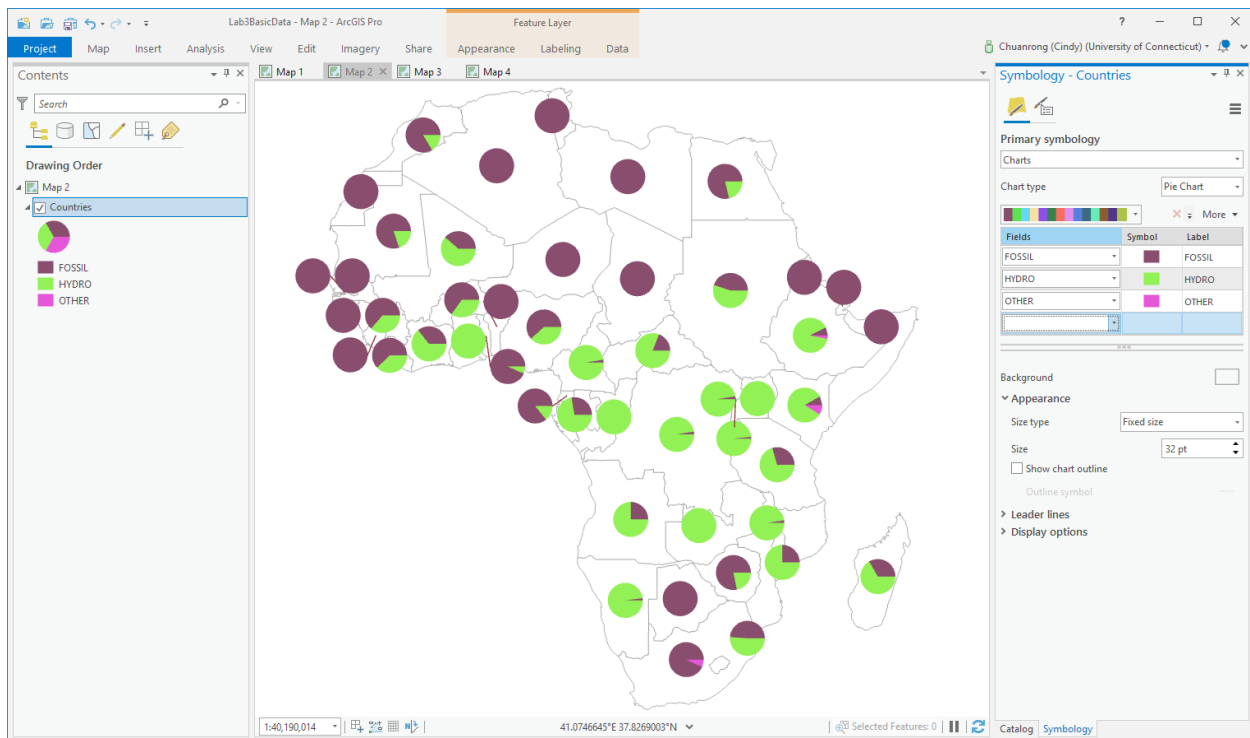
The Symbology pane  appears.




8. On the Primary symbology tab , click the Chart type drop-down menu and choose a chart type: Pie Chart
 - a. Bar Chart —Each feature attribute is symbolized with a vertical column or horizontal bar.
 - b. Pie Chart —Each feature attribute is represented as a section of a pie chart.
 - c. Stacked Chart —Each feature attribute is stacked on a single bar. Stacked chart symbols are best for displaying amounts by category.
9. In the Fields table, choose the numeric fields (Fossil, Hydro, Other) that you want to visualize in the chart symbol. Use the drop-down menu to add a field to the list.

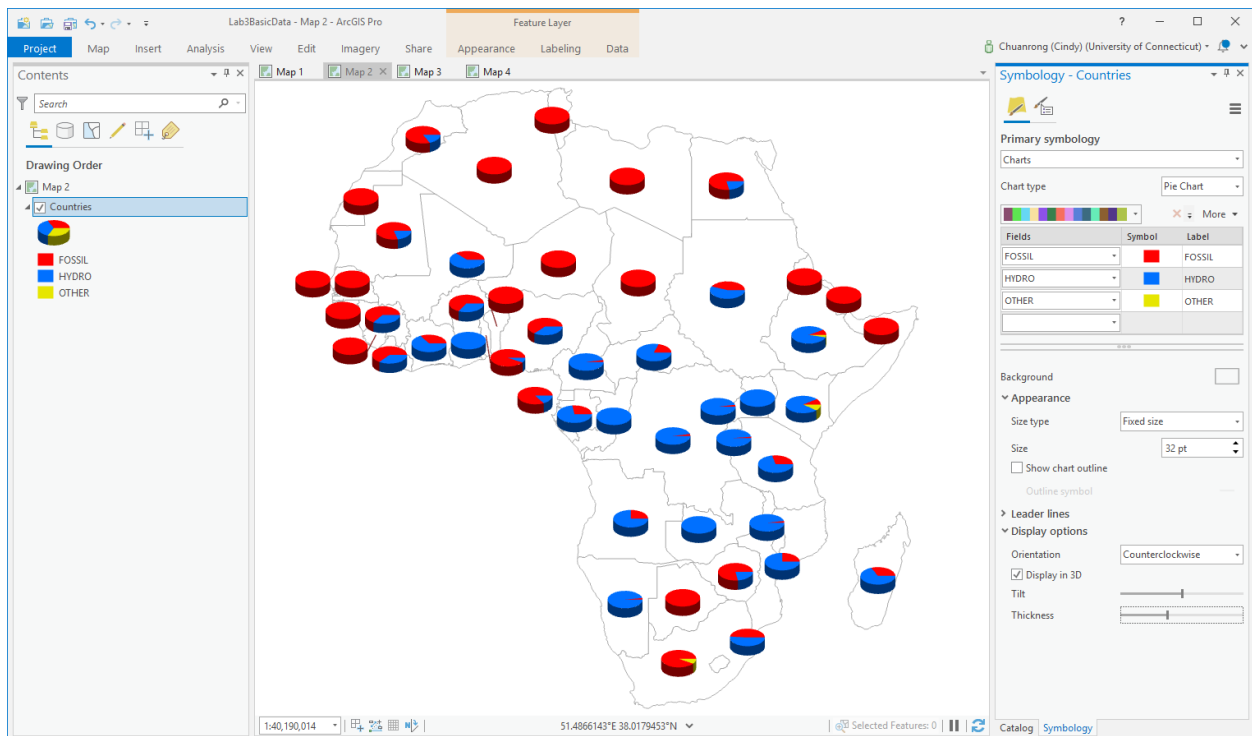
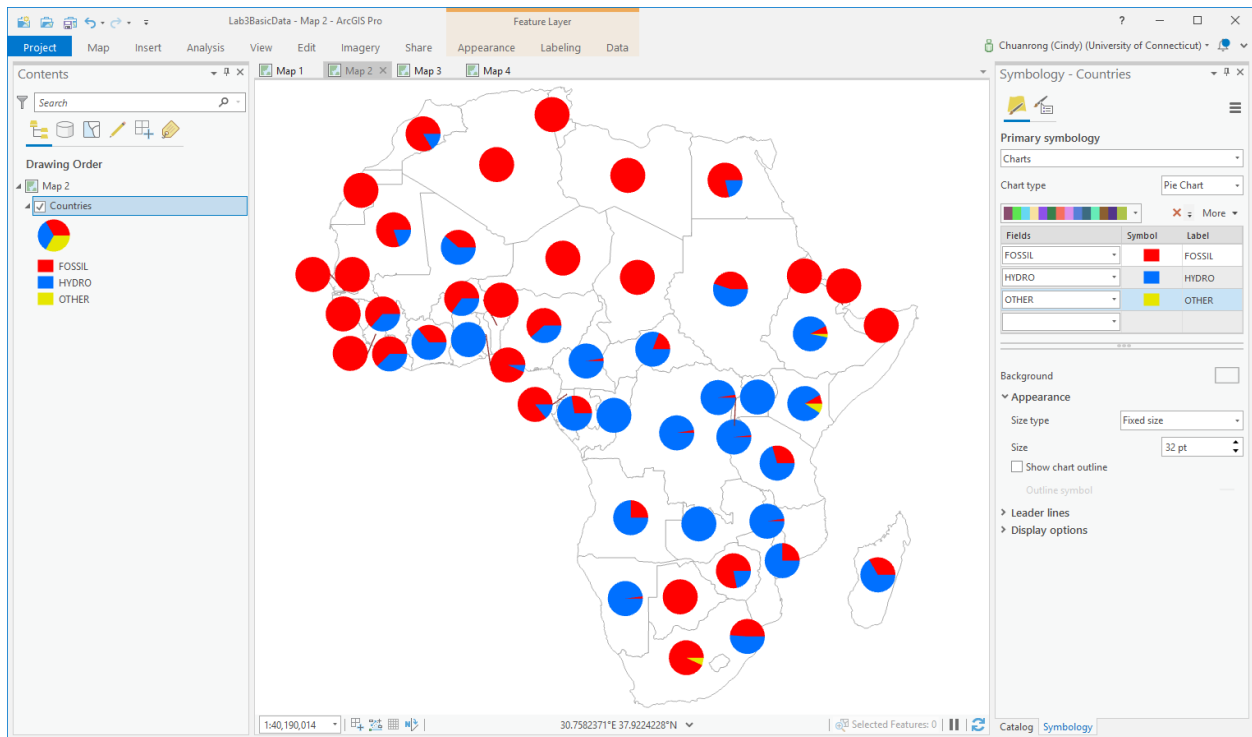
You can change the order of the fields after you add them to the list. Shift-click to select one or more fields in the list and click Move selected field(s) up  or Move selected value(s) down . You can also click More > Reverse field order to switch the order of the fields.


To remove one or more fields from the list, click Remove selected value(s) .

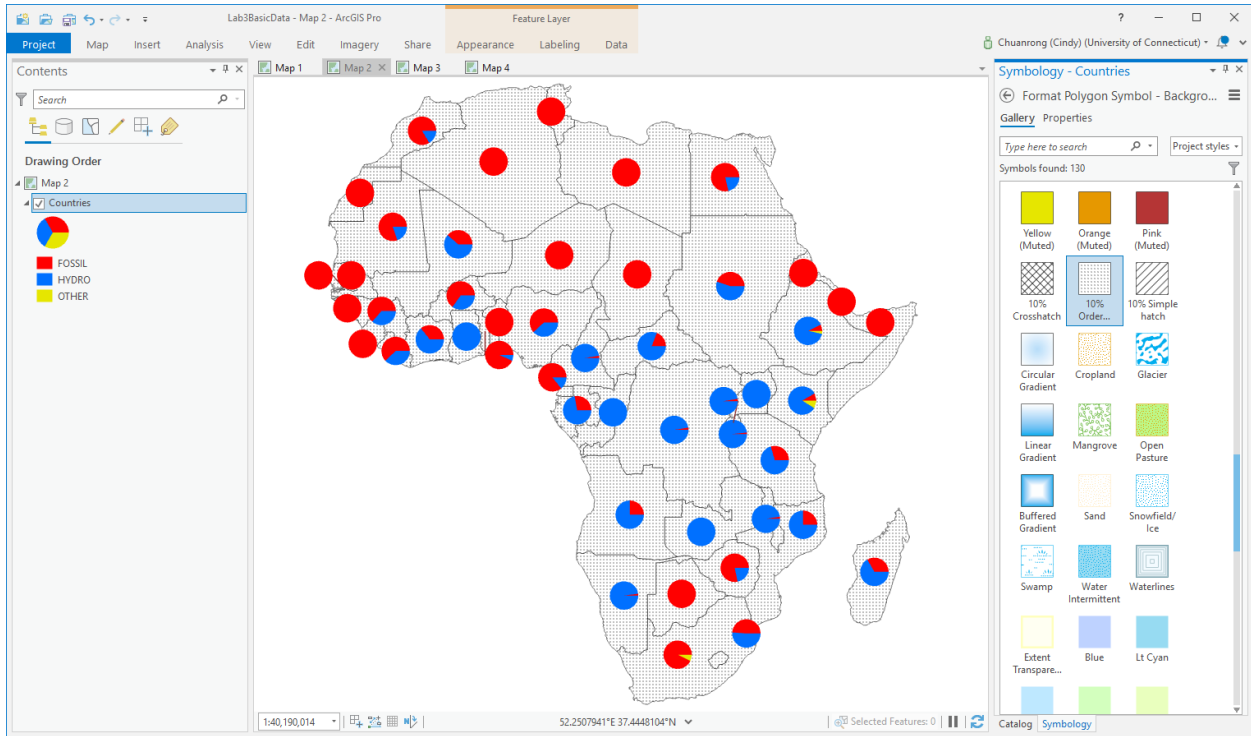


10. Use the Color Scheme drop-down menu to choose a color ramp for the chart symbols. A random color scheme is used by default. You can also double-click a symbol in the list to change its properties. For example, you may want to use transparency settings in the Color Editor on all except one field so that the attribute is emphasized in the chart symbol.
11. Optionally click More > Show excluded values to manage the symbology of excluded values. An expression can be set and modified from the Advanced symbol options tab .

12. Click the Background symbol patch to set a background fill for polygon or line features. Choose a symbol from the gallery or adjust its structure or appearance on the Properties subtab.

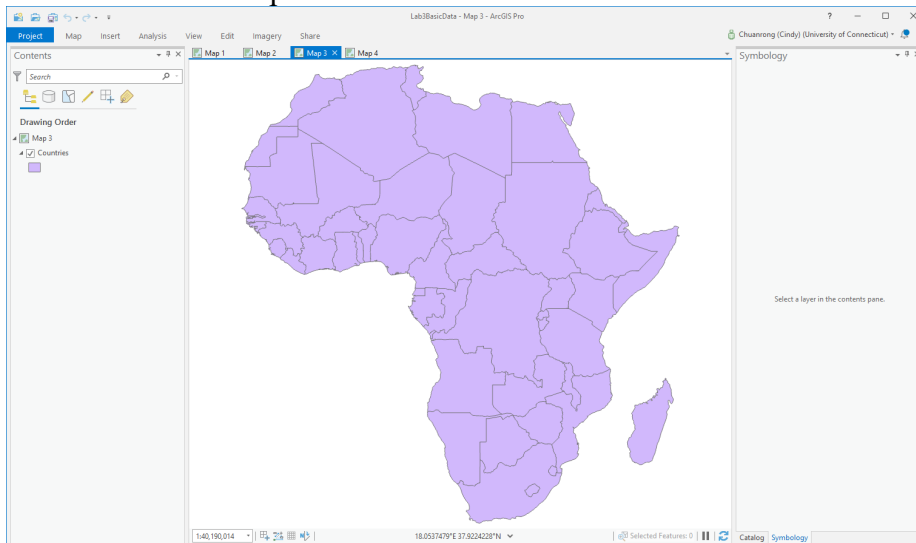


13. On this map, the 3-D effect may be a bit overwhelming.
14. Change the feature layer name to “Africa Electric Power”.
15. On the Quick Access Toolbar, click the Save button  to save the project.



- **Map 3 Africa population**

1. If necessary, click your saved “Module4LabData.aprx” to open your Module4 Lab ArcGIS Pro project.
2. Click Map 3 to activate it.

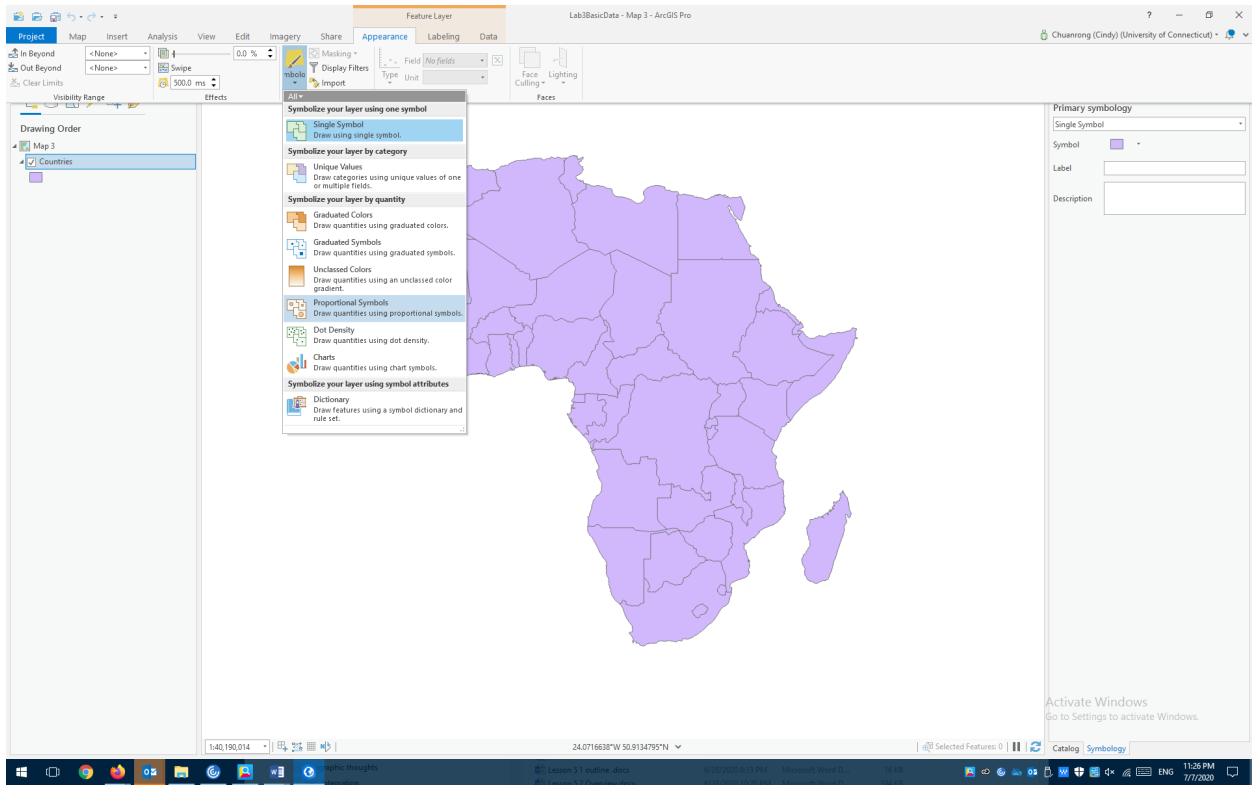


- Right-click the Countries layer and click Open Attribute Table. Scroll through the table to acquaint yourself with the various fields and records in the table. Note that there is one field labeled, **POP2000**, this is the attribute that you will map.

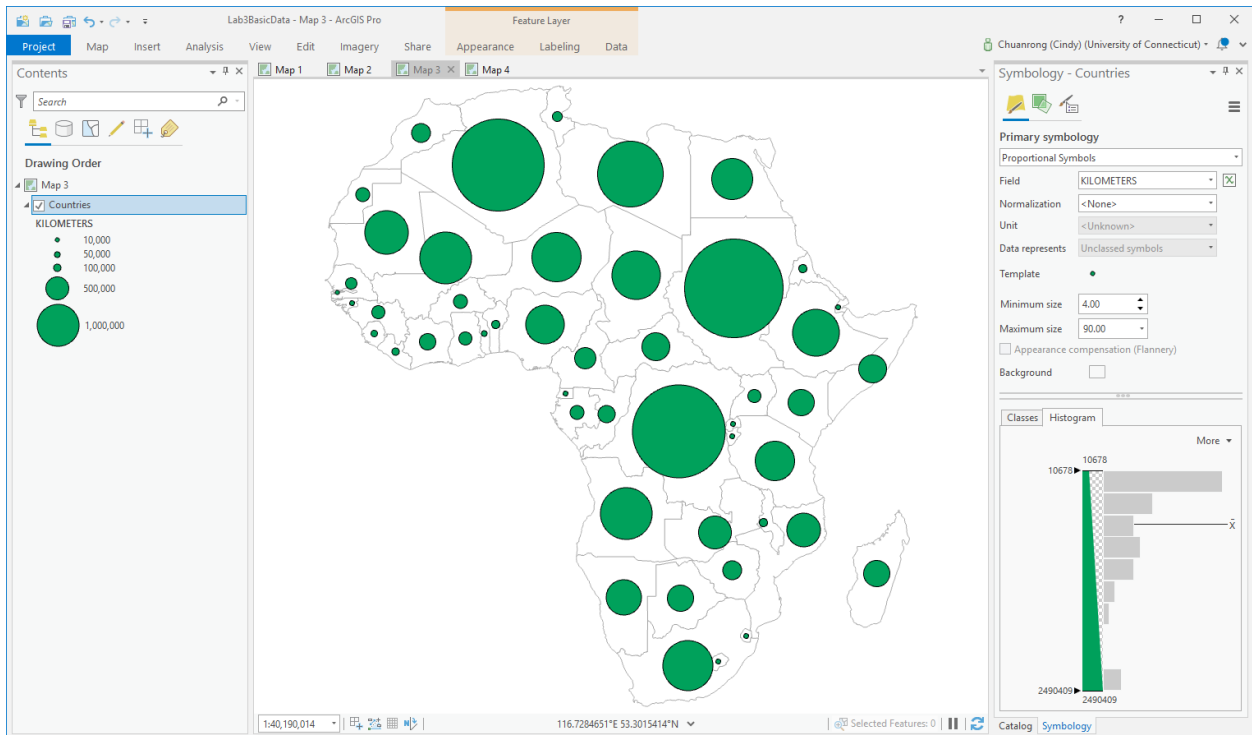
The screenshot shows the ArcGIS Pro interface with the 'Countries' attribute table open. The table contains the following data:


OBJECTID	Shape	NAME	KILOMETERS	POP1998	POP1994	POP2000	POP1980	FOSSIL	HYDRO	OTHER	Shape_Length	Shape
1	Polygon	Algeria	2320972	27459230	24453010	30489943	18669010	99.77	0.23	0	70.776952	213.5
2	Polygon	Benin	116515	5175394	4593000	6487990	3464000	100	0	0	17.168059	9.5
3	Polygon	Botswana	580011	1446623	1217000	1700875	902000	100	0	0	34.051488	50.6
4	Polygon	Burkina Faso	273719	10164690	8776001	11814948	6962000	66.44	35.56	0	27.209214	22.6
5	Polygon	Burundi	27254	6011039	5299000	7374318	4114000	1.57	98.43	0	7.783915	2.2
6	Polygon	Cent Af Rep	621499	3149545	2951000	4007031	2320000	19.05	80.95	0	42.471925	50.5
7	Polygon	Chad	1168002	6308708	5537000	7296271	4477000	100	0	0	51.846358	107.2
8	Polygon	Congo	345430	2318276	2208000	3112338	1630000	0.6	99.4	0	38.191944	27.9
9	Polygon	Djibouti	21638	450751	409700	632718	300000	100	0	0	7.330362	1.7
10	Polygon	Egypt	982910	56133430	51390000	66851491	40792000	78.72	21.28	0	53.523022	90.4
11	Polygon	Eritrea	121941	3662271	3300000	4631792	2800400	100	0	0	23.52889	10.1
12	Polygon	Ethiopia	1132328	53142970	53400000	75512339	37717010	7.35	89.34	3.31	46.966864	92.7
13	Polygon	Gambia	10678	936026	848000	1187693	634000	100	0	0	10.861138	0.8
14	Polygon	Ghana	239981	16698090	14425000	20289781	10740000	0.1	99.9	0	23.183493	19.6
15	Polygon	Guinea	246077	6242007	5547000	7412033	4461000	63.55	36.45	0	32.065958	20.1
16	Polygon	Ivory Coast	322216	13498860	11713000	18533740	8194001	35.71	64.29	0	32.089139	26.3
17	Polygon	Kenya	584429	25835250	23277010	34492815	16632000	8.27	82.74	8.99	33.14442	47.2
18	Polygon	Lesotho	30352	1928269	1722000	2310857	1355000	0	0	0	7.13803	2.8
19	Polygon	Liberia	96296	2902441	2475000	3364289	1879000	62.24	37.76	0	15.39698	7.8

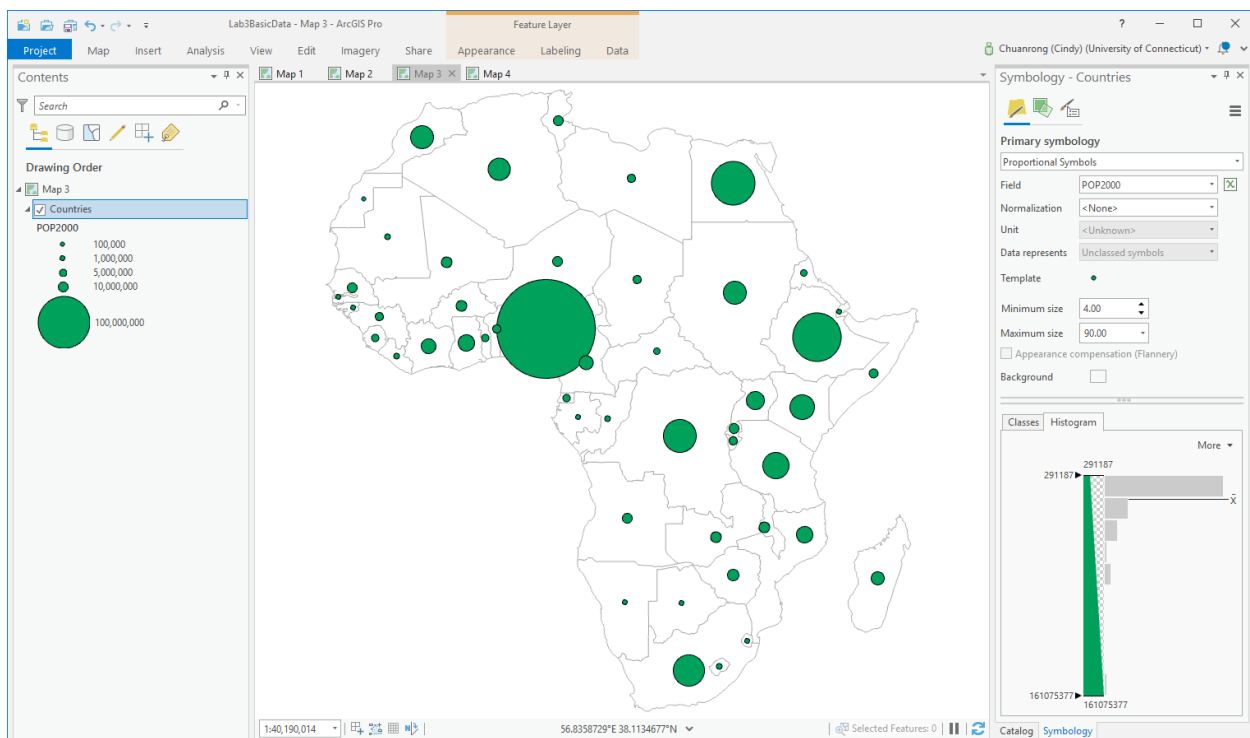
- Close the attribute table.
- Select the Countries feature layer in the Contents pane.
- On the Appearance tab, in the Drawing group, click Symbology and click Proportional Symbols.



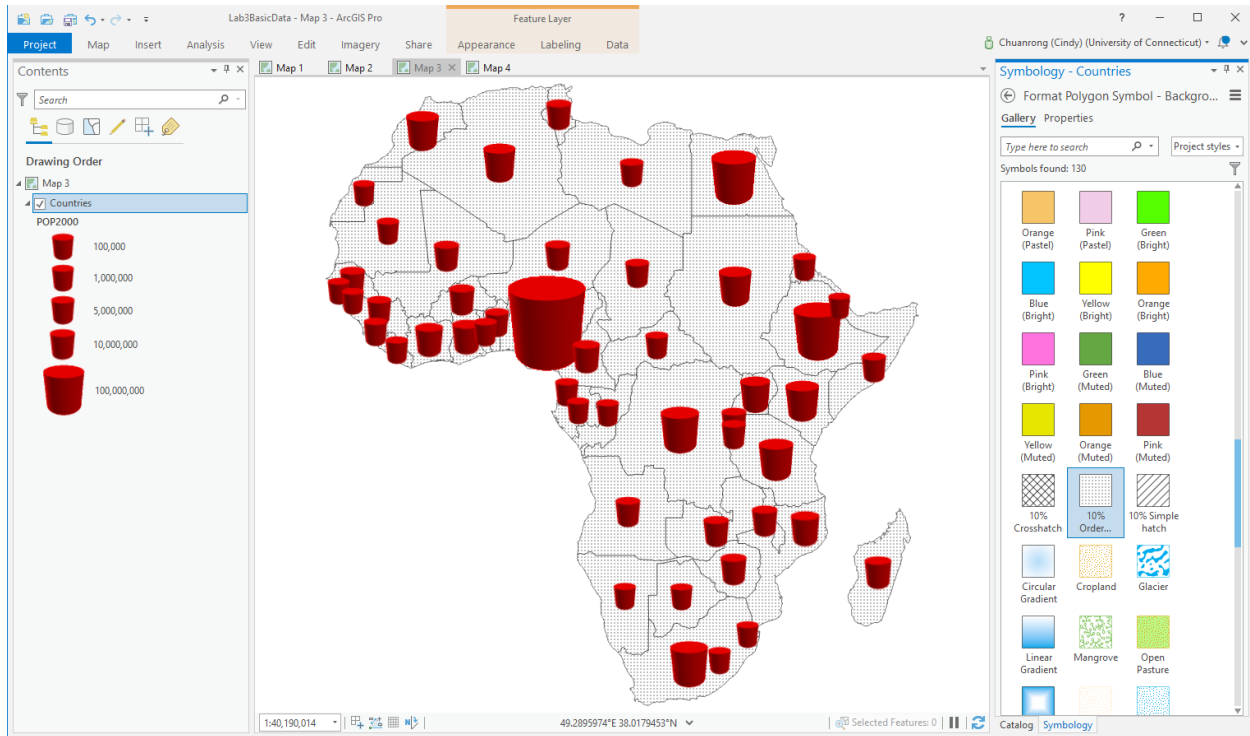
The Symbology pane appears.




7. In the Symbology pane, on the Primary symbology tab , choose the numeric field for the data to be mapped, or write an expression. In this case, choose **POP2000**.
8. To normalize the data, choose a field from the Normalization menu, or choose percentage of total to divide the data value to create ratios, or choose log to symbolize on the logarithm of each value. This can be an effective way to generate a smaller range of values if the dataset includes significant outliers. Normalization is available only when the proportional symbology is based on a field. If it is symbolized on an expression, the Normalization field is disabled. In this case, choose **<None>**.
9. Decide whether to symbolize the data with actual or relative proportional symbols. Refer to the sections above for more information. Optionally, set the minimum and maximum sizes of the symbol representing your data.
 - a. To symbolize with relative-sized proportional symbols, choose Unknown for the Unit. Set the Minimum size and the Maximum size of the symbol representing your data. Or set the Maximum size to None. Adjust the Template and the Background symbols as necessary.
 - b. To symbolize with actual-sized proportional symbols, choose a Unit to represent the data. Set the Data represents control to Area, Radius (1/2 width), Height (3D only), Width (lines only), or Distance from Center (lines only). Adjust the symbol form, symbol fill, and background symbol as needed.



10. Edit the symbol parameter until you satisfy.



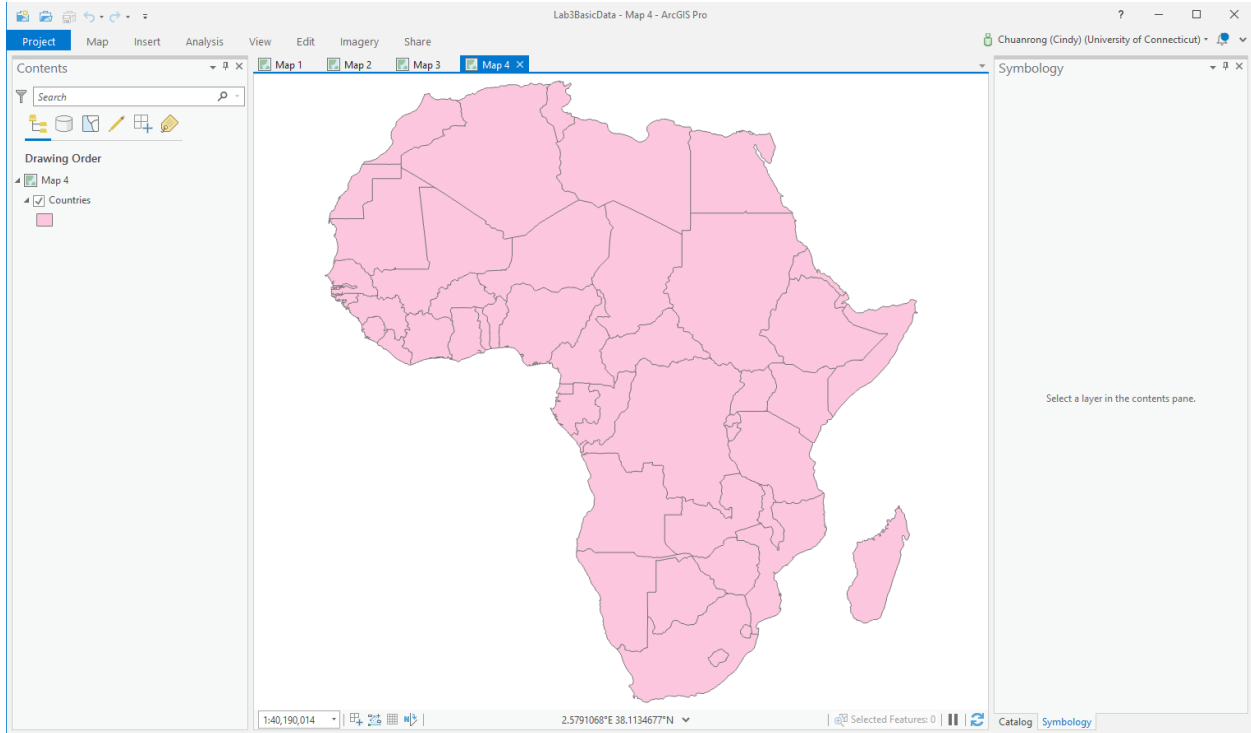
11. Change the feature layer name to “Africa Population in 2000”

12. On the Quick Access Toolbar, click the Save button  to save the project.

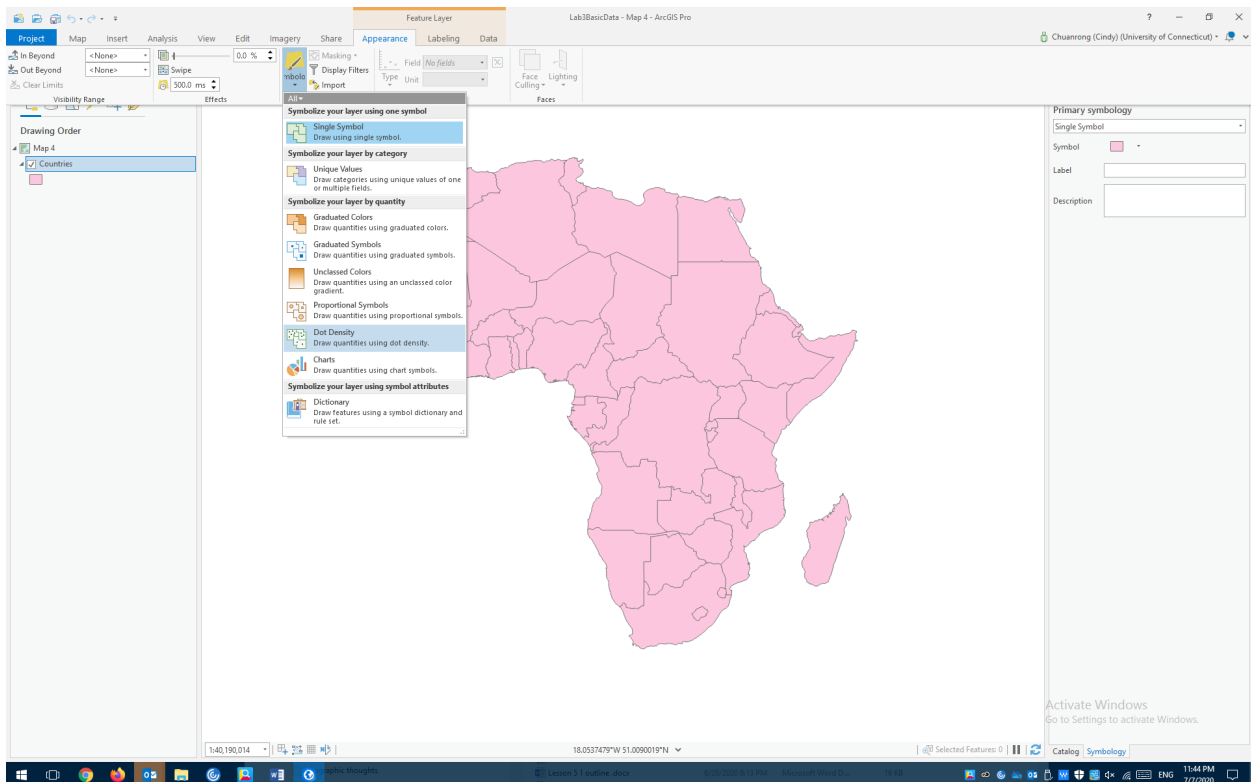
- **Map4 the distribution of Africa’s population by country**

1. If necessary, click your saved “Module4LabData.aprx” to open your Module 4 Lab ArcGIS Pro project.

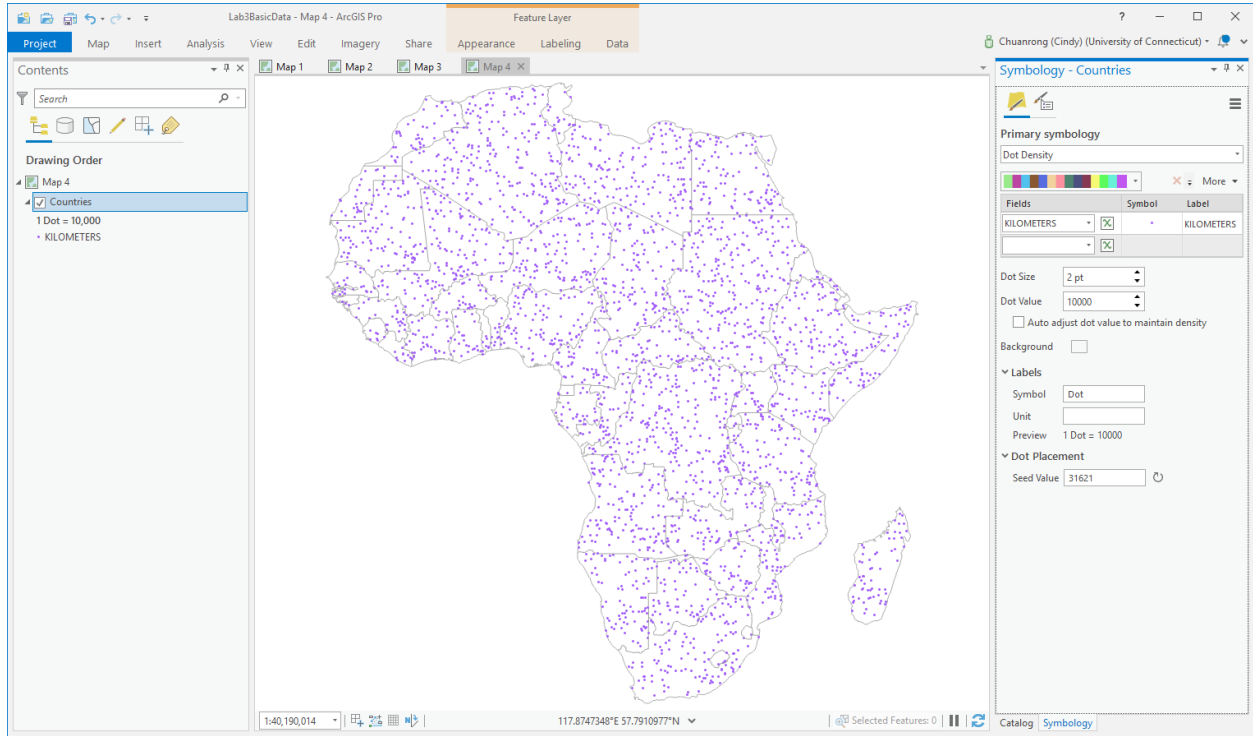
2. Click Map 4 to activate it.



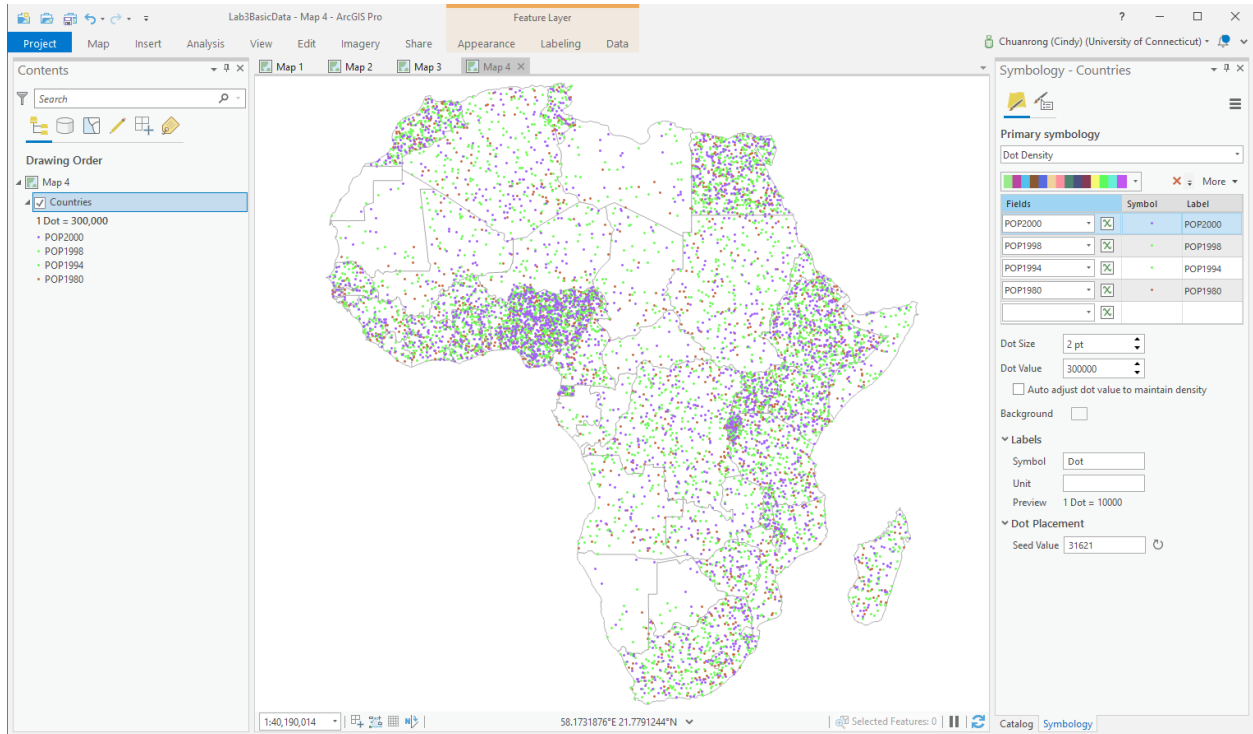
3. Select the Countries feature layer in the Contents pane.
4. On the Appearance tab, in the Drawing group, click Symbology and click Dot Density.



The Symbology pane appears.



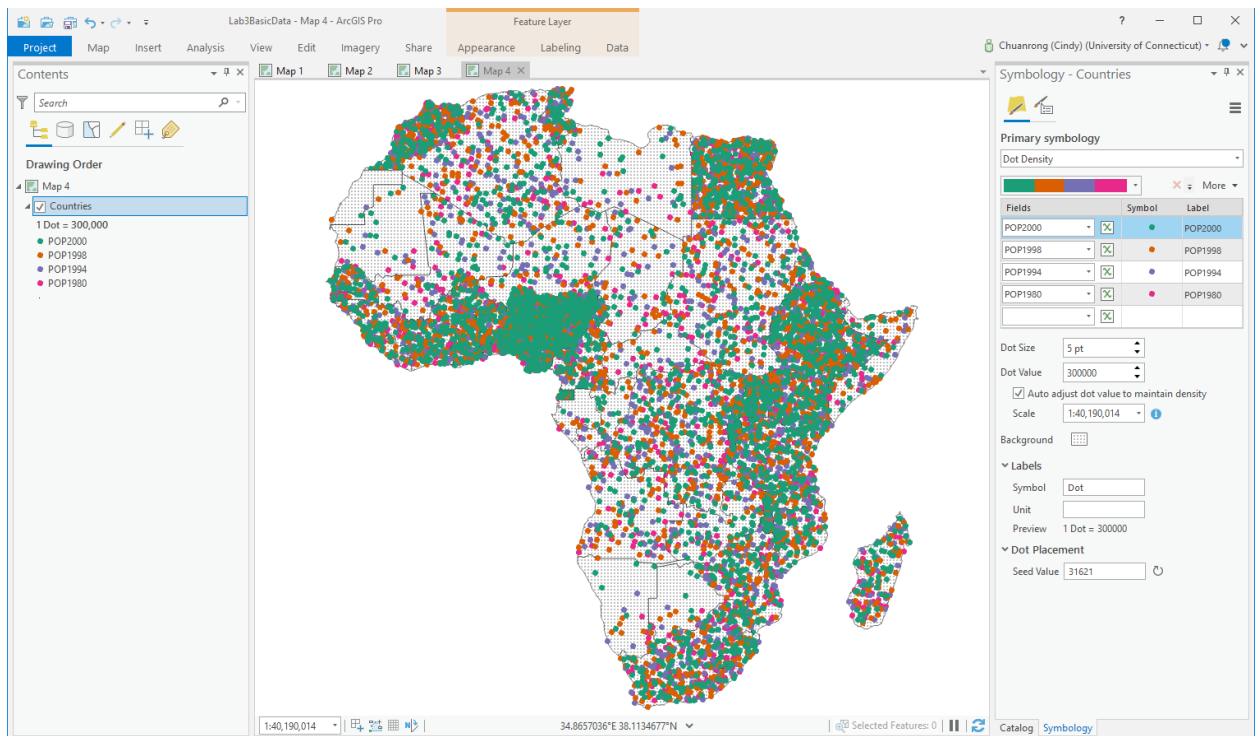
5. In the Symbology pane, on the Primary symbology tab, choose one or more numeric fields to be mapped: POP2000, POP1998, POP1994, POP1980.



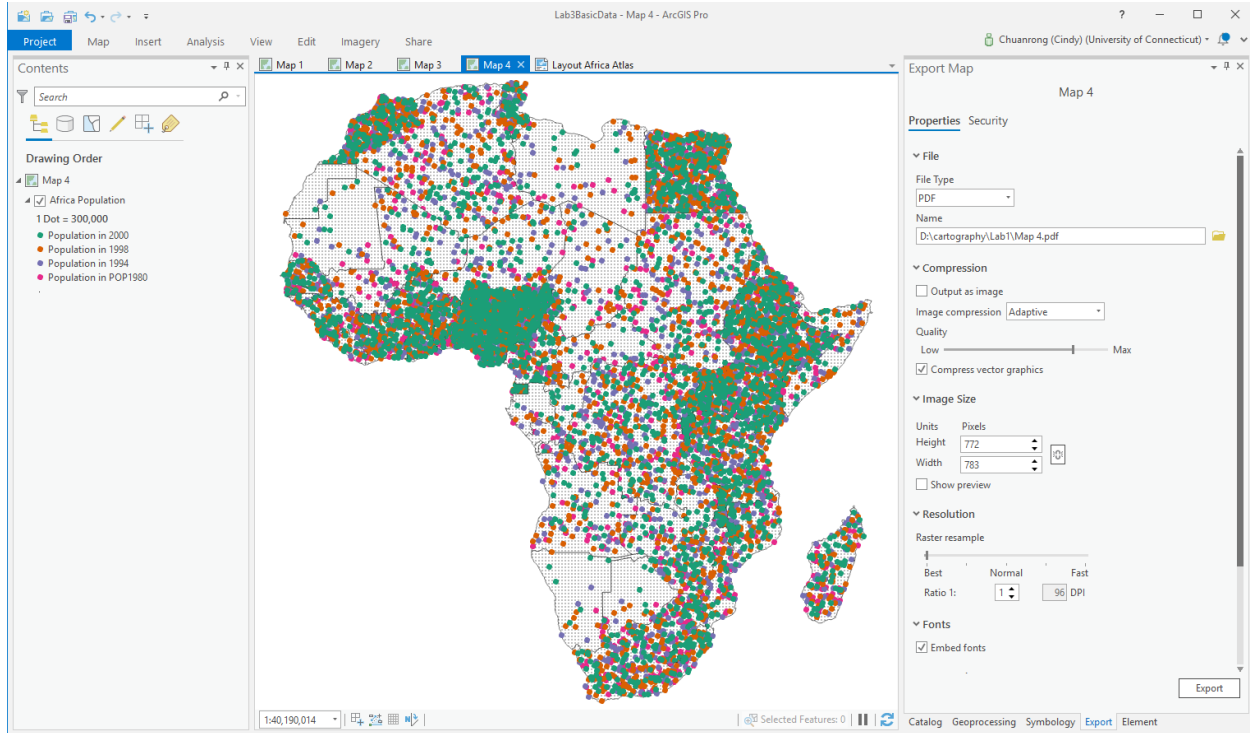
6. Choose a [color scheme](#) that assigns dot colors for each of the fields displayed as part of the dot density layer. Optionally click the symbol for each field to [modify](#).


Only the shape and color of the symbol you set in the Format Point Symbol pane are respected. The size is ignored. Dot size is dictated by the Dot Size property in the Symbology pane.

7. Change Dot Size and Dot Value as necessary to achieve appropriate density and distribution for the data.
8. Optionally click the Background symbol to modify the appearance of the polygon symbol used to display the underlying polygon features.
9. Edit the symbol parameter until you satisfy.




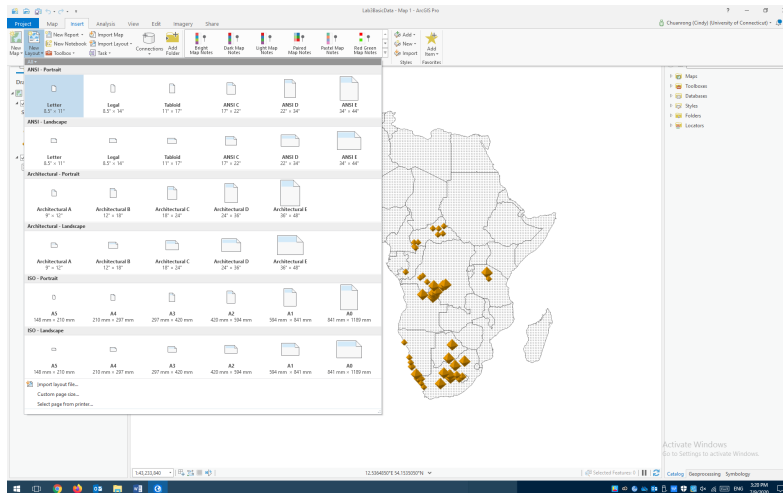
10. Change the feature layer name to “Africa Population”



1. On the Quick Access Toolbar, click the Save button  to save the project.

5. Create a Map Layout for the Africa Atlas.

1. If necessary, click your saved “Module4 LabData.aprx” to open your Module 4 Lab ArcGIS Pro project.
2. On the ribbon, click the Insert tab if necessary. In the Project group, click New Layout  to show page size and orientation options.
3. Under ANSI - Landscape, click Letter.



A new, blank layout view opens.

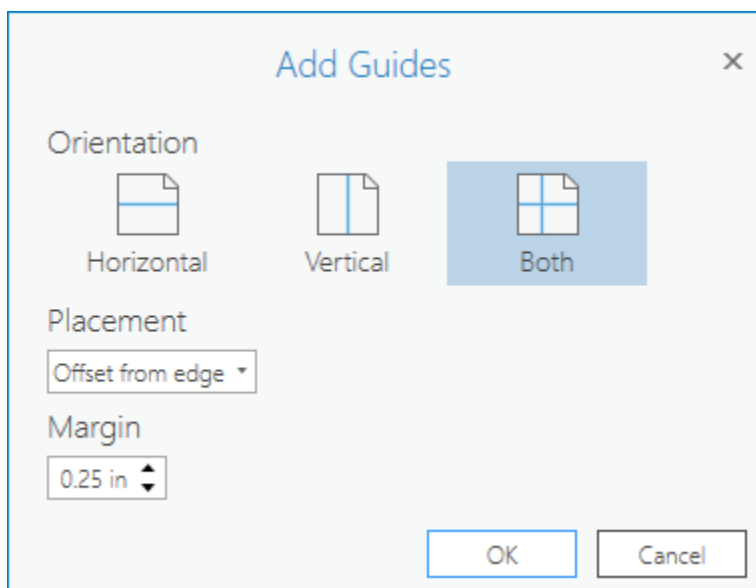
2. In the Contents pane, under Drawing Order, right-click Layout and click Properties.
3. On the Layout Properties dialog box, click the General tab if necessary. Change the name from Layout to Layout Africa Atlas and click OK.

The name change is reflected in the Contents pane and on the view tab above the ruler.

4. Right-click the top ruler and click Add Guides.

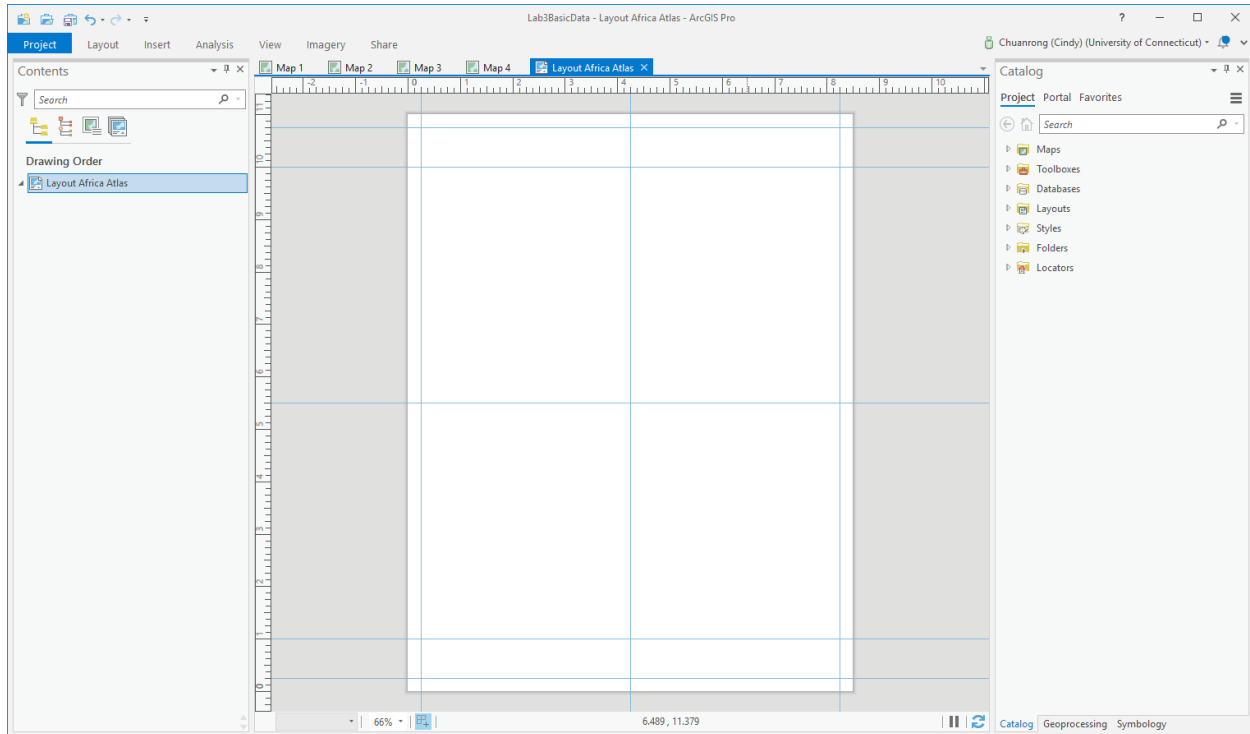
Guides are nonprinting lines that help you align elements on the layout.


5. On the Add Guides dialog box, under Orientation, click Both.
6. Click the Placement drop-down menu and click Offset from edge.
7. Replace the value in the Margin box with 0.25 in. Click OK.



Guides are added to the layout at one-quarter inch from each margin.

8. Right-click the top ruler and click Add Guides again.
9. On the Add Guides dialog box, for Orientation, click Horizontal. For Placement, click Offset from edge. Change the Margin value to 1 in. Click OK.
10. On the Add Guides dialog box, for Orientation, click Horizontal. For Placement, click Center. Click OK.
11. On the Add Guides dialog box, for Orientation, click Vertical. For Placement, click Center. Click OK.

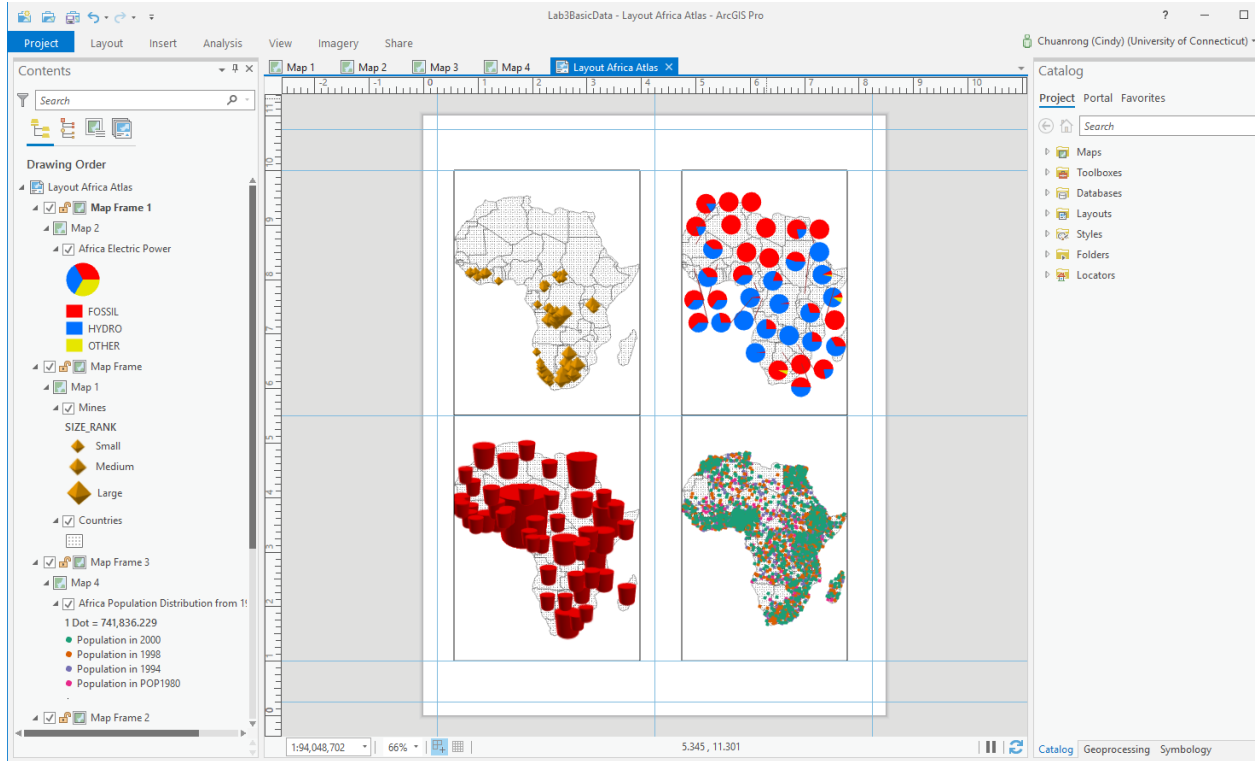


12. On the Quick Access Toolbar, click the Save button  to save the project.

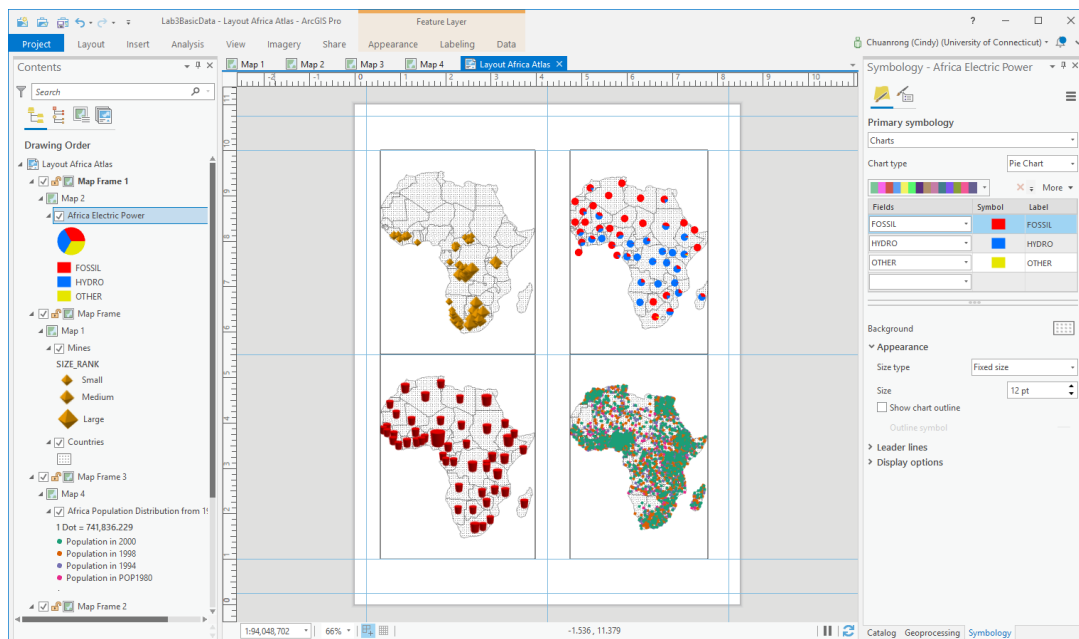
Insert a map frame

Now you'll add the 4 maps to the layout.

1. On the ribbon, on the Insert tab, in the Map Frames group, click the Map Frame drop-down menu to insert the 4 maps to the layout.



- Resizing the map frame changes the scale and extent of the map, so you may want to make adjustments. To work with the map as a map—rather than as a layout element—you activate the map frame. Change the sizes of map symbols to fit the Map Layout.



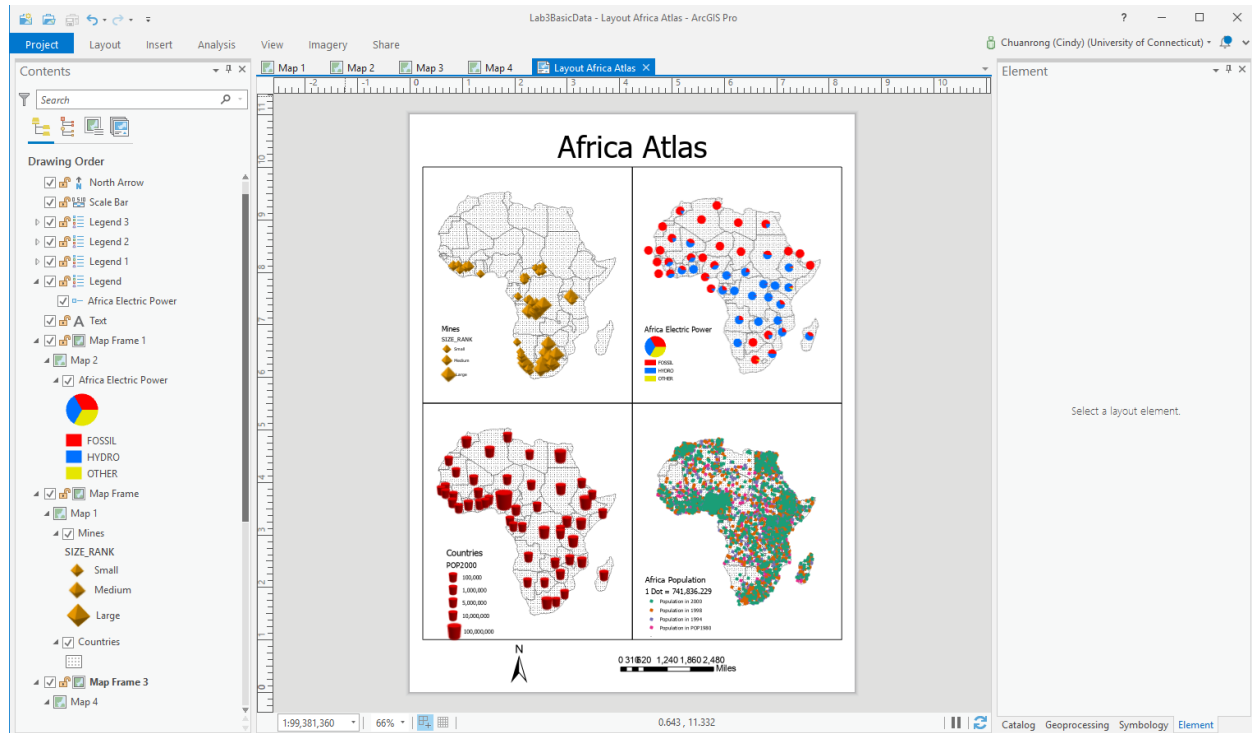
Insert map surrounds

You'll add a Title, legend, north arrow, and scale bar to the layout.

If you forget how to add these map surrounds, please read the helps from the below website:

<https://pro.arcgis.com/en/pro-app/get-started/add-maps-to-a-layout.htm>

- The Title of the map should be “Africa Atlas”

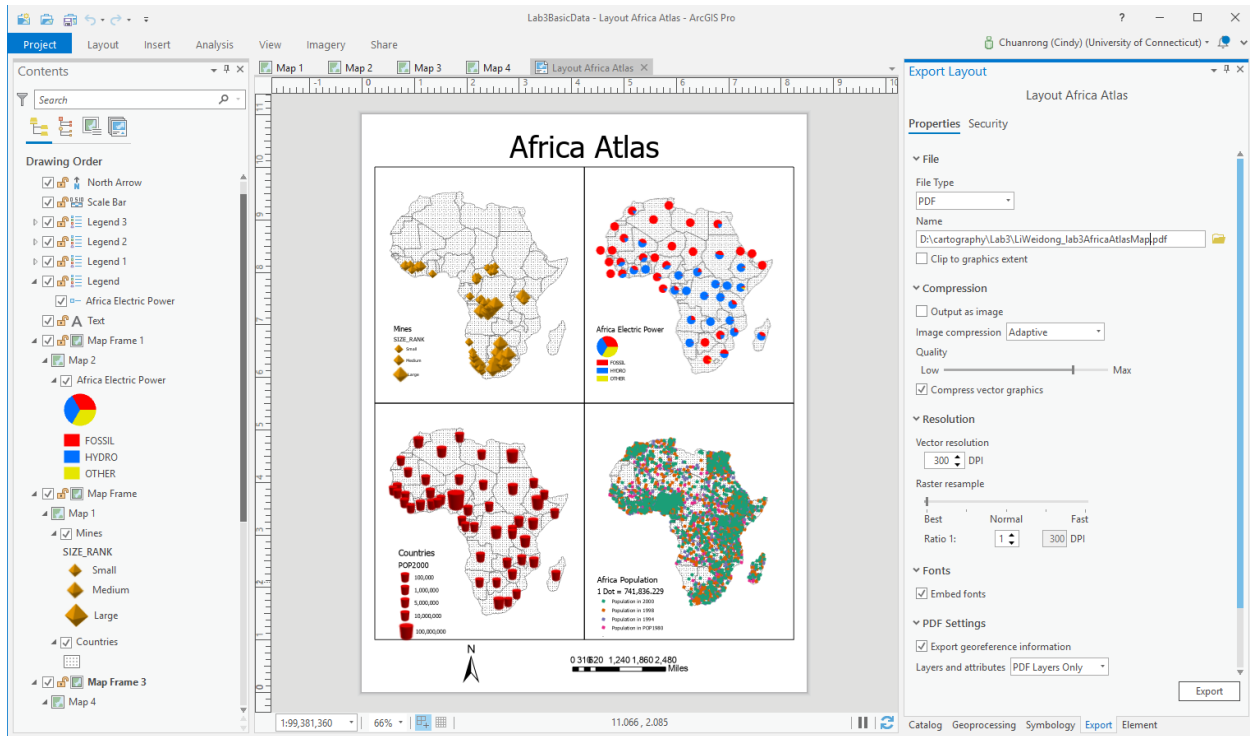


Export the final layout as PDF file.

- On the ribbon, click the Share tab. In the Export group, click Layout →.

The Export Layout pane appears. On the Properties tab, change File Type to PDF, if necessary.

- In the Name box, click the Browse button  and browse to the location where you want to save the file. Use the name **“YourLastNameFirstName_Module4LabAfricaAtlasMap.pdf”**



Please notes: this map layout has some problems and it's not a perfect map. This is just used for illustration purpose.