

ArcGIS

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Agenda

- 1 **Intro**
- 2 **Downloading ArcGIS**
- 3 **Finding / Reading Shapefiles**
- 4 **Data Management**
- 5 **Styling the Map**
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Intro

- ArcGIS, owned by company called ESRI, been around for 50+ years
- Active online community (subreddits, stackexchange, youtube, ESRI resource center)
- Built atop Python, though using Python is not necessary for making maps
- Users use SQL to manager data
- Works with two types of data:
 - (1) Raster (“picture” data, like a basemap)
 - (2) Vector (“point” data, with latitude and longitude. Can also include projected polygons)
- Pros: (1) Easy to learn, (2) So many options, (3) “Point and click” spatial stats
- Cons: (1) Can be slow, (2) Crashes frequently (save often!), (3) Quirks, like the state of Montana projects 3x wider than normal, and (4) Map key/legend tool is just awful, (5) ESRI charges \$\$\$\$ for extra features

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Downloading ArcGIS

Website: <https://lib.stanford.edu/stanford-geospatial-center/arcgis-102-software-download>

The screenshot shows the 'ArcGIS 10.2.2 Software Download' page. At the top is a navigation menu with links: HOME, ABOUT US, LEARN GIS, CONSULTATIONS, PROJECT SHOWCASE, DOWNLOAD SOFTWARE, and FIND DATA AT BR. Below the menu is the title 'ArcGIS 10.2.2 Software Download' and a paragraph stating that Stanford maintains a campus-wide site license agreement with Esri. A section titled 'License Requirements' explains that the software is for installation on Stanford-affiliated computers only. A 'Downloads' section contains a red warning: 'Please read before installing: ArcGIS installation files are provided as .iso files, which must be unzipped before using. Wir'. Below this are three download options, each with an icon and a 'click to download' button: 1. 'ArcGIS Desktop Advanced' with a computer monitor icon. 2. 'ArcGIS 10.2 Data and Maps' with a CD icon, described as 'Pre configured basemaps and thematic data for ArcGIS Desktop:'. 3. 'ArcGIS 10.2 Tutorial Data' with a CD icon, described as 'Data necessary to complete the tutorials available on Arc GIS Desktop:'. A red arrow points from the 'ArcGIS Desktop Advanced' button to the first step of the instructions on the right.



Free for Stanford Affiliates

Steps if you use Windows OS:

1. Make sure you can automatically unzip files (need tool like 7-zip or WinRAR)
2. Download from here
3. Follow Directions under section “Concurrent Licensing” lower down the page

If you have a Mac: contact stacemaples@stanford.edu for assistance or use this guide:

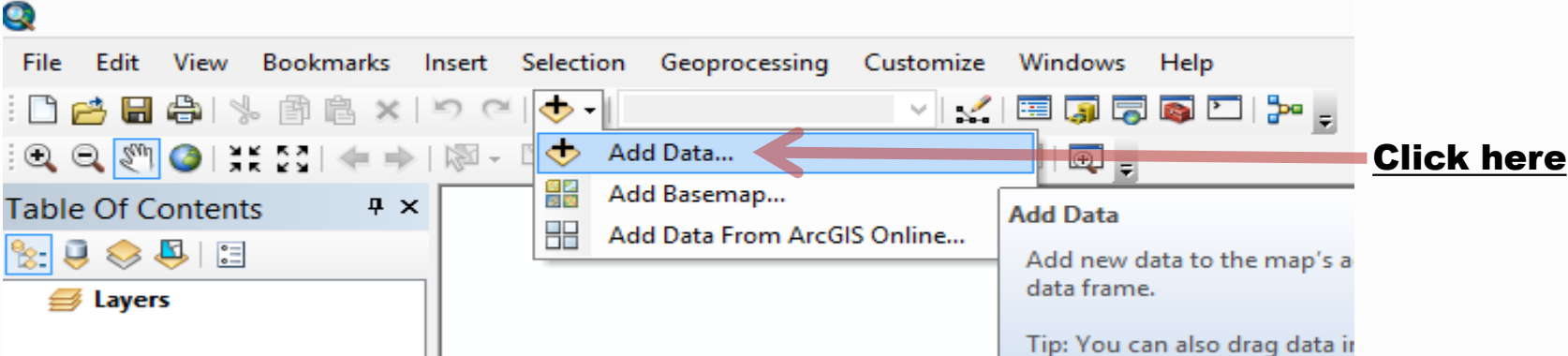
<https://lib.stanford.edu/files/ArcGIS%20to%20MacOS%20install%20notes.pdf>

Or use QGIS (open source ArcGIS)- <http://www.qgis.org/en/site/forusers/download.html>

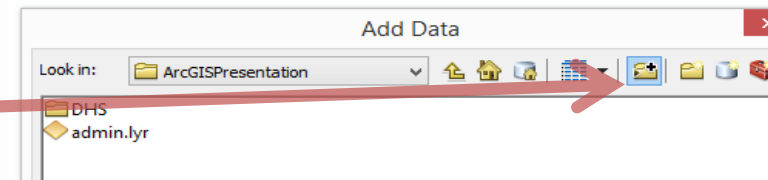
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Finding / Reading Shapefiles

1. Google is your friend- just search for the geography you need, plus the word shapefile
example: "US counties shapefile". See Resources at end to learn about various data sources
2. Download, and save on your desktop (for now)
3. Open up **ArcMap** (it's the one you'll be using 99.9% of the time) and open up a blank map

4.  The screenshot shows the ArcMap software interface. The menu bar includes File, Edit, View, Bookmarks, Insert, Selection, Geoprocessing, Customize, Windows, and Help. Below the menu bar is a toolbar with various icons. The 'Add Data...' option is highlighted in blue, and a red arrow points to it from the text 'Click here' on the right. Below the 'Add Data...' option are 'Add Basemap...' and 'Add Data From ArcGIS Online...'. A 'Table Of Contents' panel is visible on the left, and a 'Layers' panel is at the bottom left. A 'Tip: You can also drag data in' is visible in the bottom right of the 'Add Data' dialog box.

5. Then choose the folder w/ the plus sign on the top right

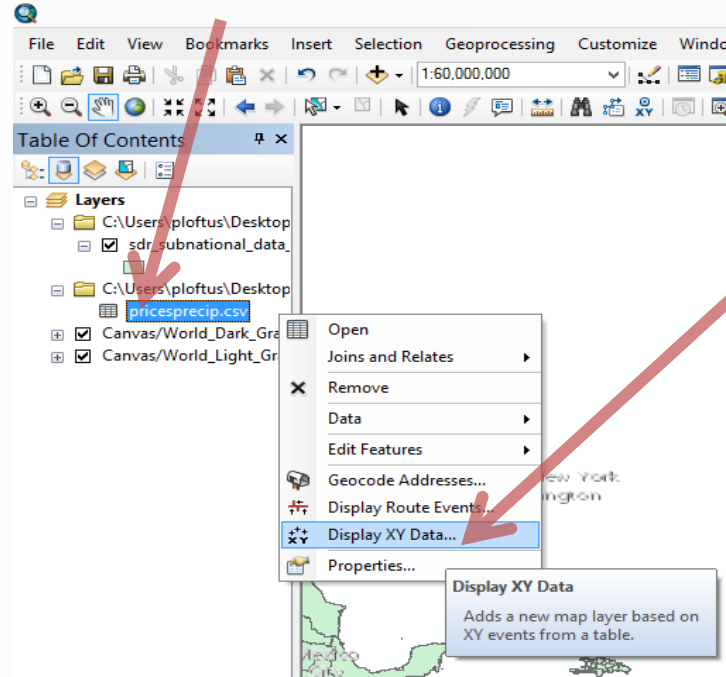


6. Select the folder with your Shapefile and "add" the .shp file to the map
7. Recall in Step 4 that beneath "Add Data" was the option "Add Basemap". Choose that option now and choose your basemap (I'm partial to "Light Gray Canvas")

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Finding / Reading Shapefiles

8. You should now have your data with the basemap behind it. Let's now add in some vector data. Either find this online, or make a list of points, with latitude and longitude in a csv file.
9. Repeat Step #4, but instead of adding in the .shp file, add in the .csv file.
10. To make the points show up, right-click on the .csv file, and choose "Display XY Data".



Displaying Lat and Lon Coordinates

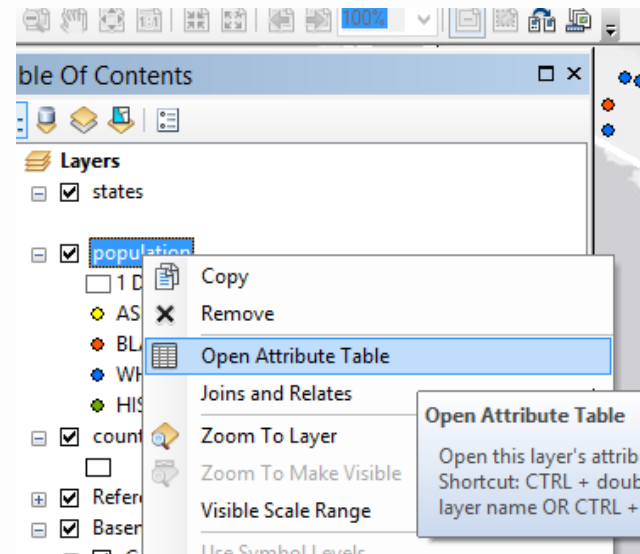
11. For the X-coord, choose longitude, and for the Y-coord, choose latitude.
12. Admire/check your work. (Make sure none of the vector data are in a body of water, if they're supposed to be on land. This is a surprisingly common issue)

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Finding / Reading Shapefiles

Checking your Data

- 1). Right-click on layer name
- 2). Select "Open Attribute Table"
- 3). Look at Attribute Table, can Sort Columns, Summarize Data, Delete Fields (Columns), and check Data Type (Properties)



Table

population

FID	Shape *	NAME	STATE_NAME	POP2000	POP00_SQMI	POP2010	POP10_SQMI	WHITE	BLACK	AMER_ES	ASIAN	HAWN_PI	HISPANIC
0	Polygon	Lake of the Woods			2.5	4045	2.3	3874	14	28	33	0	35
1	Polygon	Ferry			3.2	7551	3.3	5758	26	1259	52	8	254
2	Polygon	Stevens					17.1	38923	145	2413	237	68	1185
3	Polygon	Okanogan					7.7	30399	159	4675	237	31	7227
4	Polygon	Pend Oreille					9.1	11907	52	488	73	16	391
5	Polygon	Boundary					8.6	10398	29	189	62	6	402
6	Polygon	Lincoln					5.4	18881	23	182	60	9	462
7	Polygon	Flathead			14.2	90928	17.3	86802	201	1028	531	58	2070
8	Polygon	Glacier			4.4	13399	4.4	4165	17	8795	26	1	241
9	Polygon	Toole			2.7	5324	2.7	4896	29	241	23	1	129
10	Polygon	Liberty			1.5	2339	1.6	2296	2	5	3	1	8
11	Polygon	Hill			5.7	16096	5.5	11896	50	3497	67	7	373
12	Polygon	Sheridan			2.4	3384	2	3229	7	57	14	0	51
13	Polygon	Divide			1.8	2071	1.6	2030	5	11	7	0	30
14	Polygon	Burke			2	1968	1.7	1924	4	15	14	0	37
15	Polygon	Renville			2.9	2470	2.8	2419	2	10	5	0	24
16	Polygon	Bottineau	North Dakota	7149	4.2	6429	3.8	6112	25	136	16	1	82
17	Polygon	Rolette	North Dakota	13674	14.6	13937	14.8	2825	21	10763	16	1	133
18	Polygon	Towner	North Dakota	2876	2.8	2246	2.2	2173	2	49	1	0	10
19	Polygon	Cavalier	North Dakota	4831	3.2	3993	2.6	3902	4	37	9	1	24
20	Polygon	Pembina	North Dakota	8585	7.7	7413	6.6	7077	21	144	11	2	190
21	Polygon	Kittson	Minnesota	5285	4.8	4552	4.1	4484	11	4	16	0	69
22	Polygon	Deerwood	Minnesota	46338	6.7	46338	6.3	44767	20	204	202	2	416

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Data Management

The Coordinate System

* Right-click layer name > Properties > Layer Properties Window > Source Tab

The Source tab tells you (1) which folder the map is stored in,

(2) which table the data is coming from,

(3) which variables are being mapped as latitude and longitude, and

(4) the geographic coordinate system being used to project the data. The one shown here,

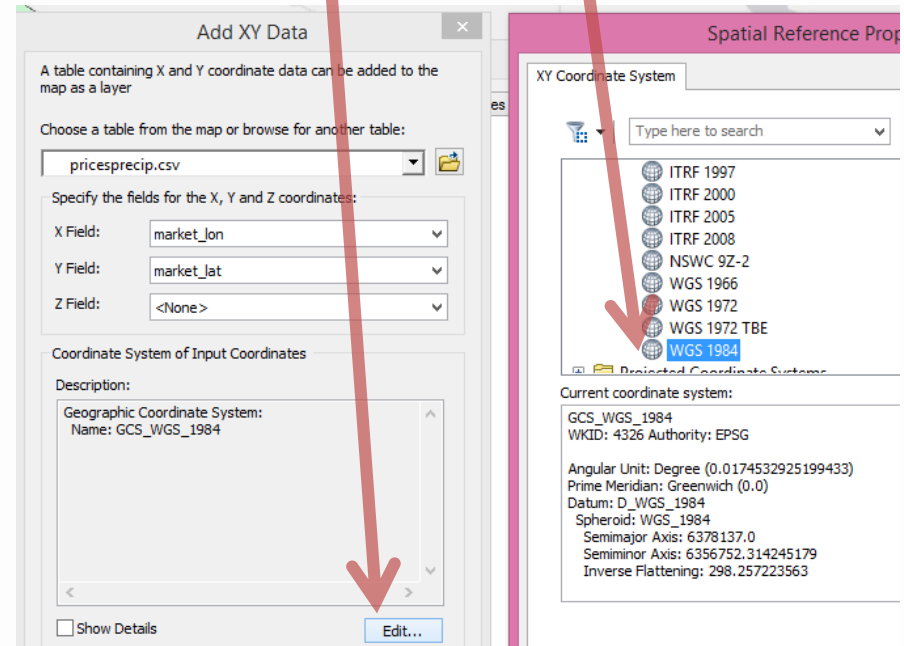
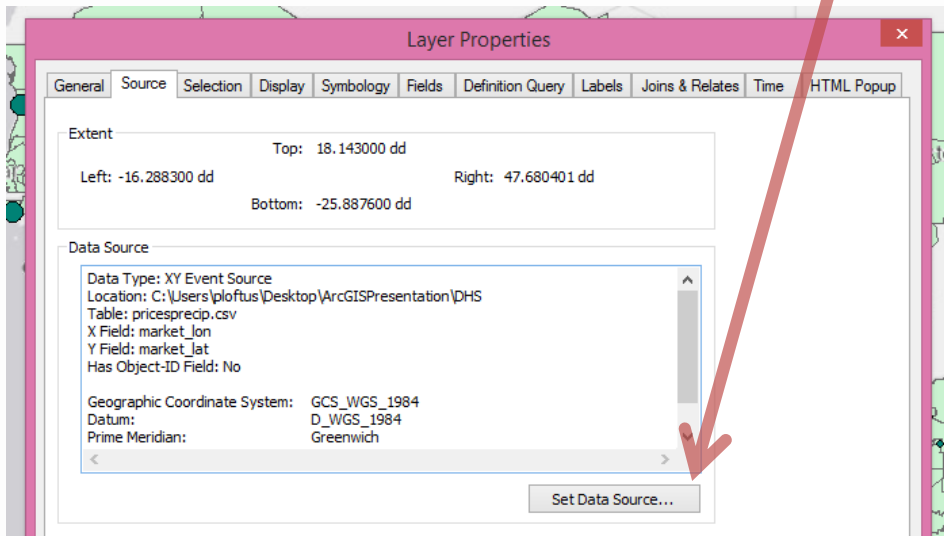
“GCS_WGS_1984” is the default coordinate system, which most shapefiles will have.

All of the layers on your map MUST have the same Coordinate System.

If they don't, you must (1) click on “Set Data Source” and change it.

(2) Then Click “Edit”

(3) Then choose WGS 1984 (or whatever)

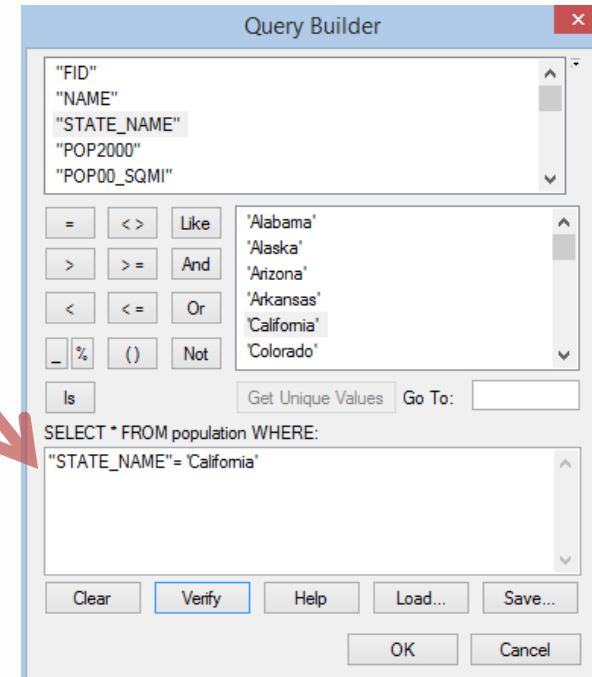
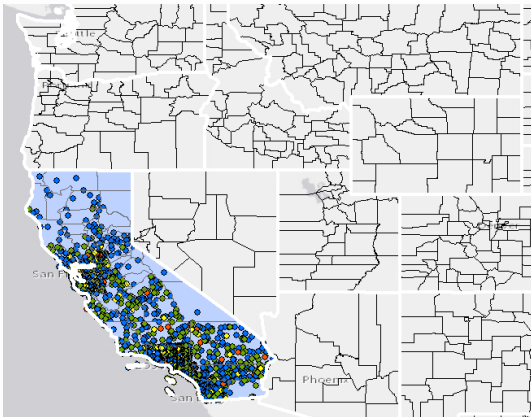


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Data Management

Query your data using SQL to filter out rows you don't need

1. Right-click layer name, select “Properties”, click on the “Definition Query” tab, and then choose “Query Builder...”
2. Once in Query Builder, the Select statement is already written. You just define the WHERE Clause, and you do this by clicking. No need to know SQL.
3. EXAMPLE: You have population data for all of the US, at the county level. You only want data For California. This is what that looks like:
4. Click “Verify” to ensure you did it right.
5. Then click OK to seal the deal, and you should now only see data for California.



4

Data Management

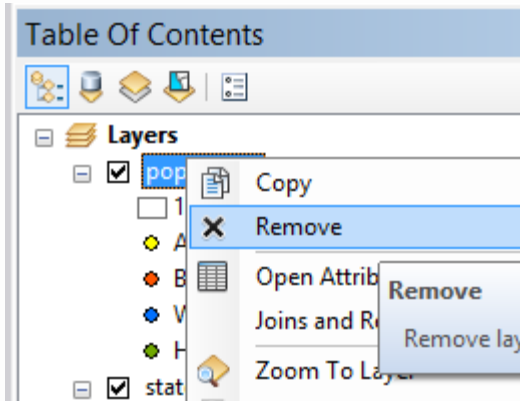
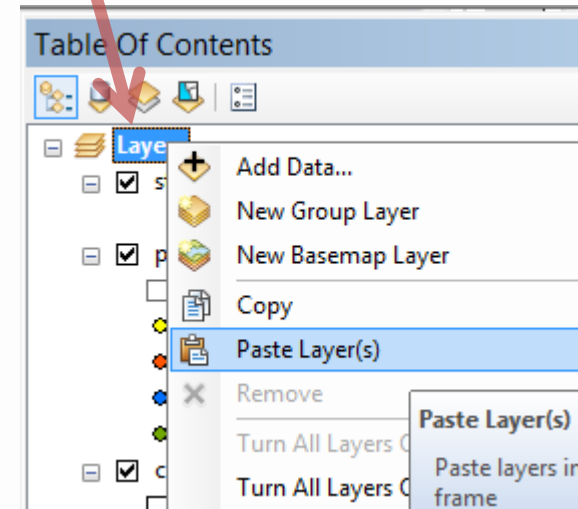
Preparing for Joining/Merging Data- making a copy of your layer

Copy layer (highlight name, Ctrl+C) and paste it into the very top “Layer”

Now you have a copy, so if you screw up the one you’re working with, you can always go back to the copy.

The copy is also useful if you want to have two layers, each using a different fields from the same data table, or want to build off of the first layer while keeping the first layer intact. It saves time.

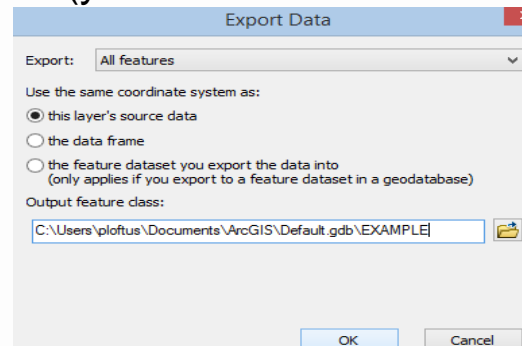
It’s always easy to remove a layer later: (right click layer name + Remove)



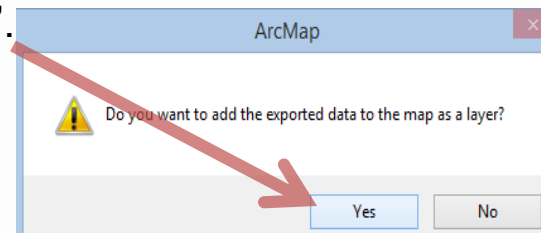
4 Data Management

Preparing for Joining/Merging Data- Export Layer

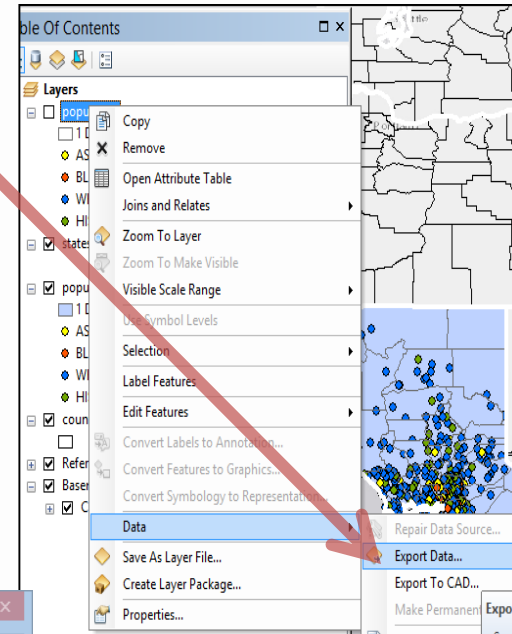
1. Right-click layer name, select “Data”, and choose “Export Data”
2. Choose a place to output data (you will now have it as a shapefile) and give it a name (EXAMPLE)



3. This window will pop up. Choose “Yes”.



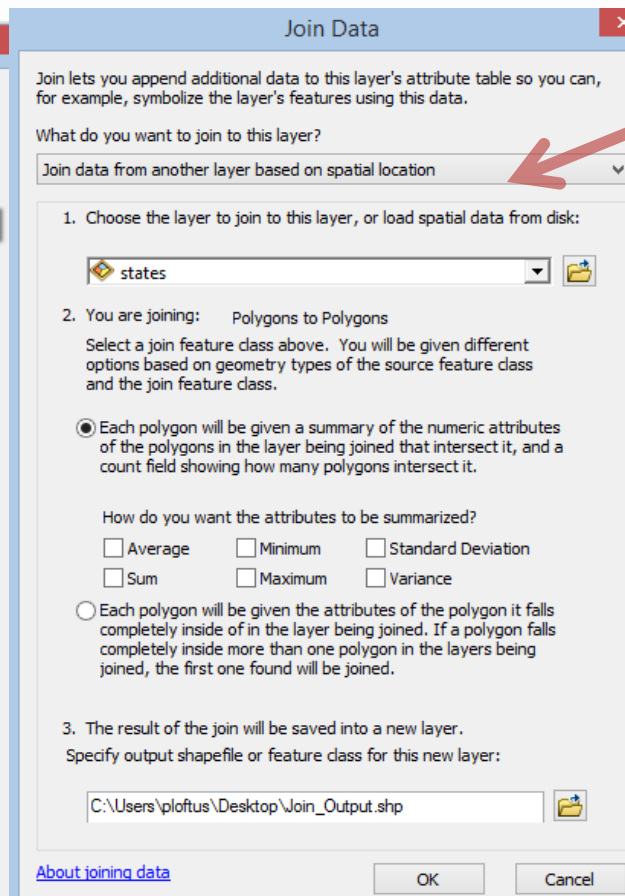
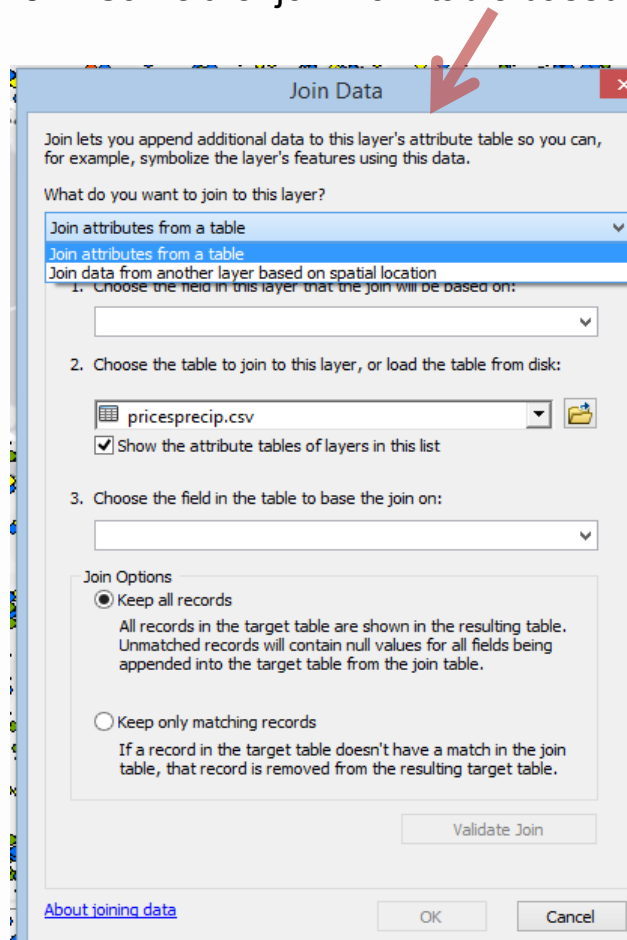
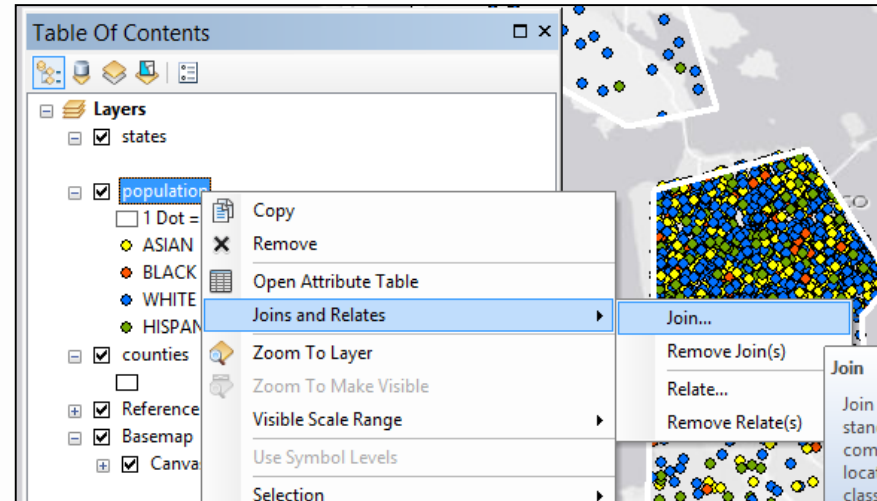
4. Now, use the new layer, as it's better integrated w/ ArcGIS. The map is now shareable, as the layer is independent of files on your computer. If you previously filtered this layer using the query builder, that is now permanent, and you only have data for California in this layer (before, the filter could be reversed). Joining is also easier and less likely to result in an error message.



4 Data Management

Joining/Merging Data

1. Right-click on the Layer Name (population)
2. Select “Joins and Relates” and then “Join...”
3. Can either join from table based on a common field...

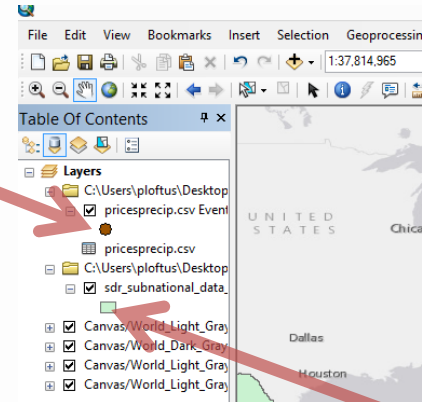
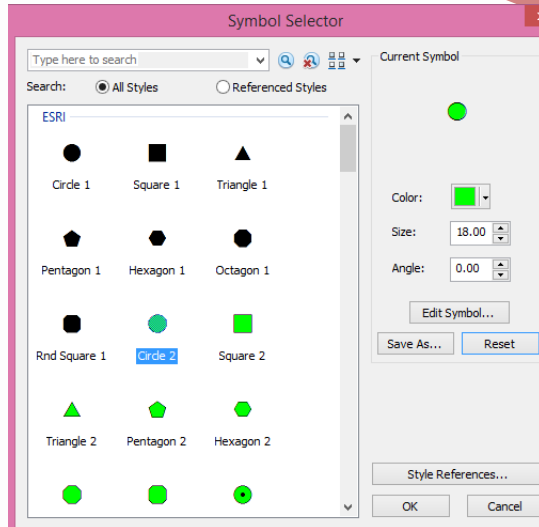


4. ...or Join Spatially
5. If Joining Spatially, say a file with state-level data with another layer where there are multiple numeric data points per state, you can summarize the multiple data points. Or you can slap the layers on top of each other and hope for the best (Option below).
6. Check the Attribute Table to make sure that the join worked.

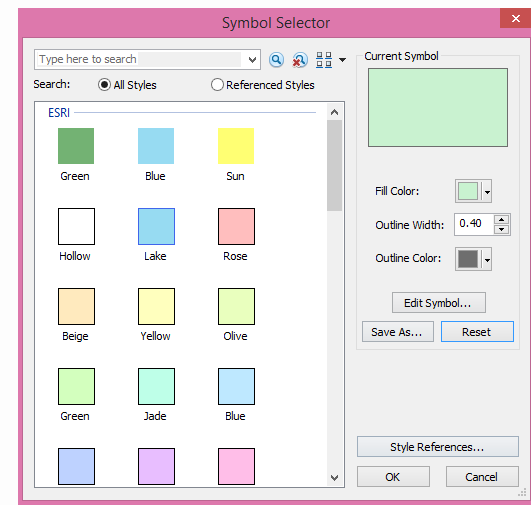
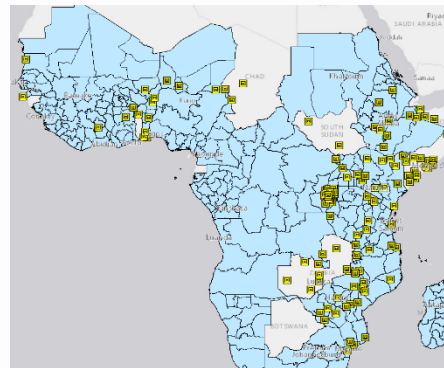
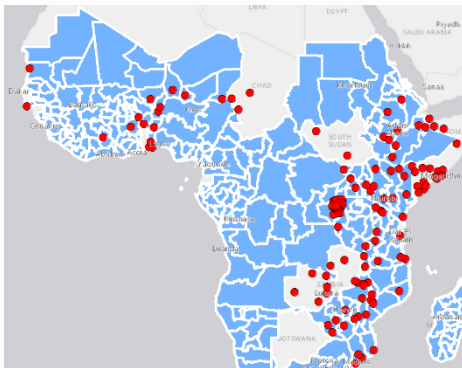
5 Styling the Map

Basic Symbology- Symbol Selector

To alter the size and/or color of your vector data symbology (i.e., points), click on the point.



You can also change the fill and outline of your data by clicking on it.

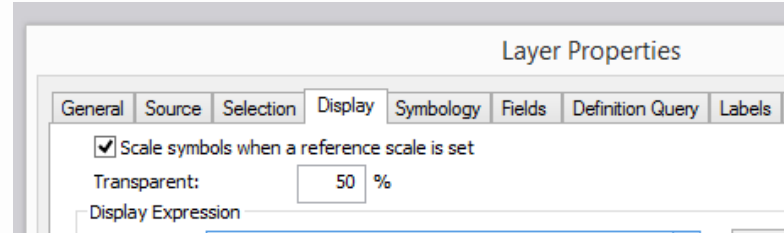


5

Styling the Map

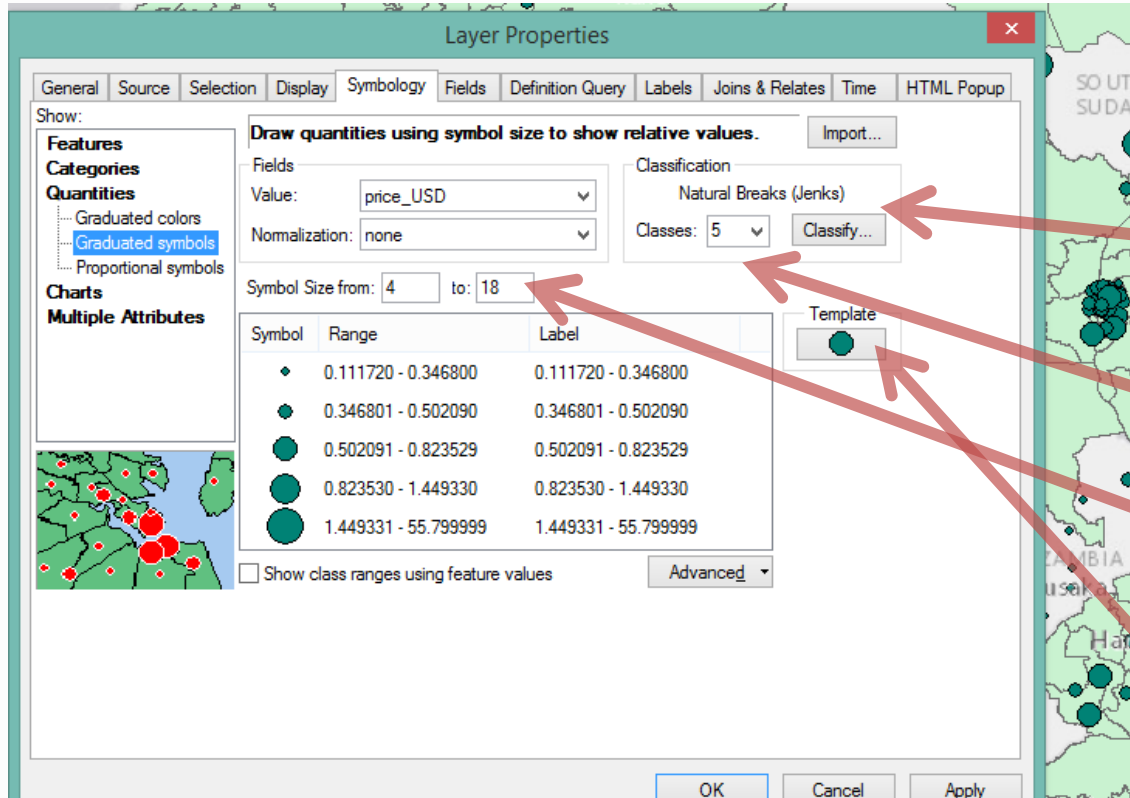
Properties > Display Tab

To Change the Transparency
(Make layers more/less see-through)



[Vector Data]

Properties > Symbology Tab > Quantities > Graduated symbols



The Symbology tab will allow you to alter the color/shape of your data in accordance with data values.

You can click on Classify to choose how to define the cut-offs (quantiles, manual, etc..)

Change the # next to classes
To change the # of levels.

Change
Color/Shape and Size

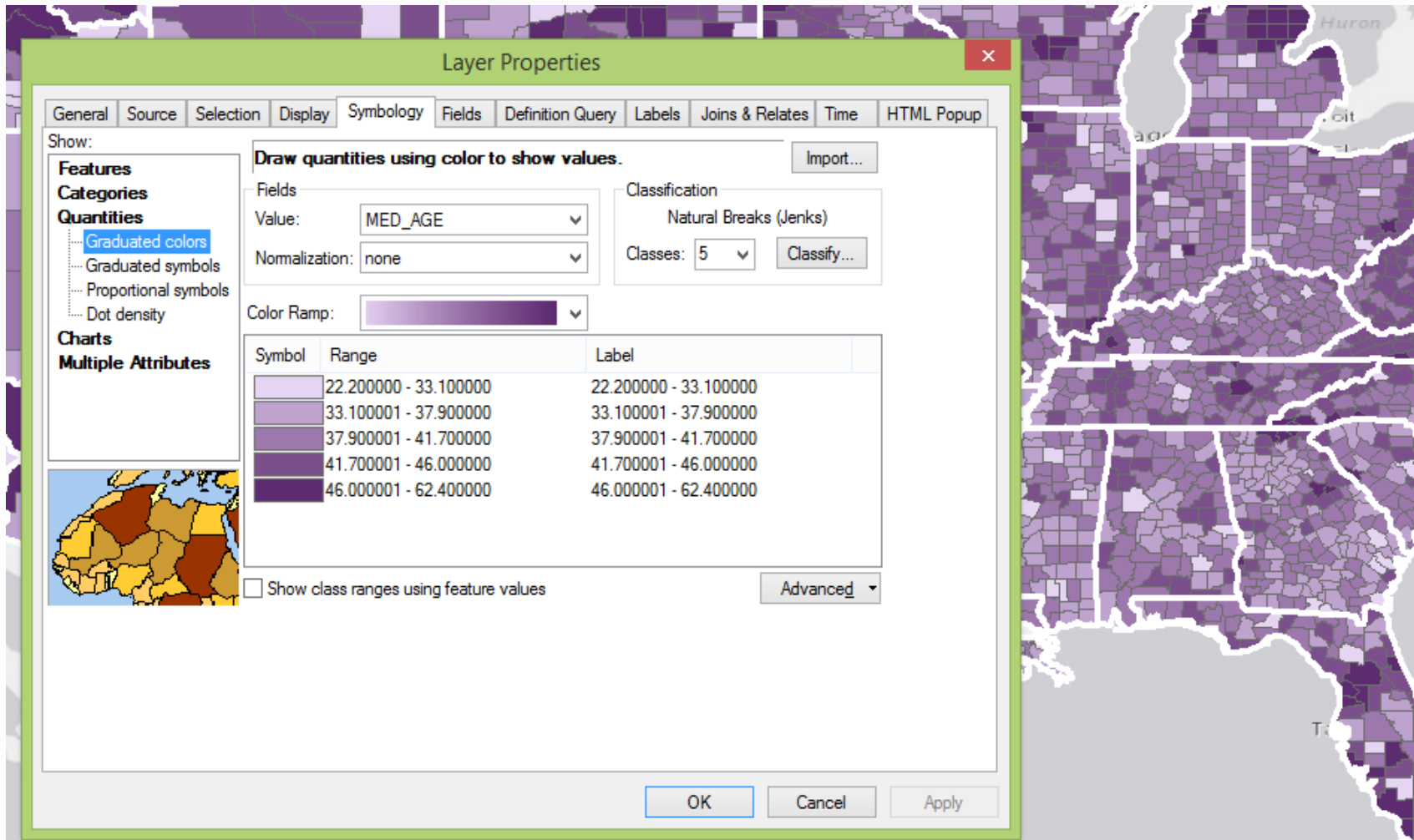
5

Styling the Map

Classic Heat Map

[Polygon Data]

Properties > Symbology Tab > Quantities > Graduated colors



Layer Properties

General Source Selection Display Symbology Fields Definition Query Labels Joins & Relates Time HTML Popup

Show:

- Features
- Categories
 - Quantities
 - Graduated colors
 - Graduated symbols
 - Proportional symbols
 - Dot density
 - Charts
 - Multiple Attributes

Draw quantities using color to show values. Import...

Fields: Value: MED_AGE

Classification: Natural Breaks (Jenks)

Normalization: none

Classes: 5 Classify...

Color Ramp: [Color Ramp]

Symbol	Range	Label
[Light Purple]	22.200000 - 33.100000	22.200000 - 33.100000
[Medium-Light Purple]	33.100001 - 37.900000	33.100001 - 37.900000
[Medium Purple]	37.900001 - 41.700000	37.900001 - 41.700000
[Dark Purple]	41.700001 - 46.000000	41.700001 - 46.000000
[Very Dark Purple]	46.000001 - 62.400000	46.000001 - 62.400000

Show class ranges using feature values

Advanced

OK Cancel Apply

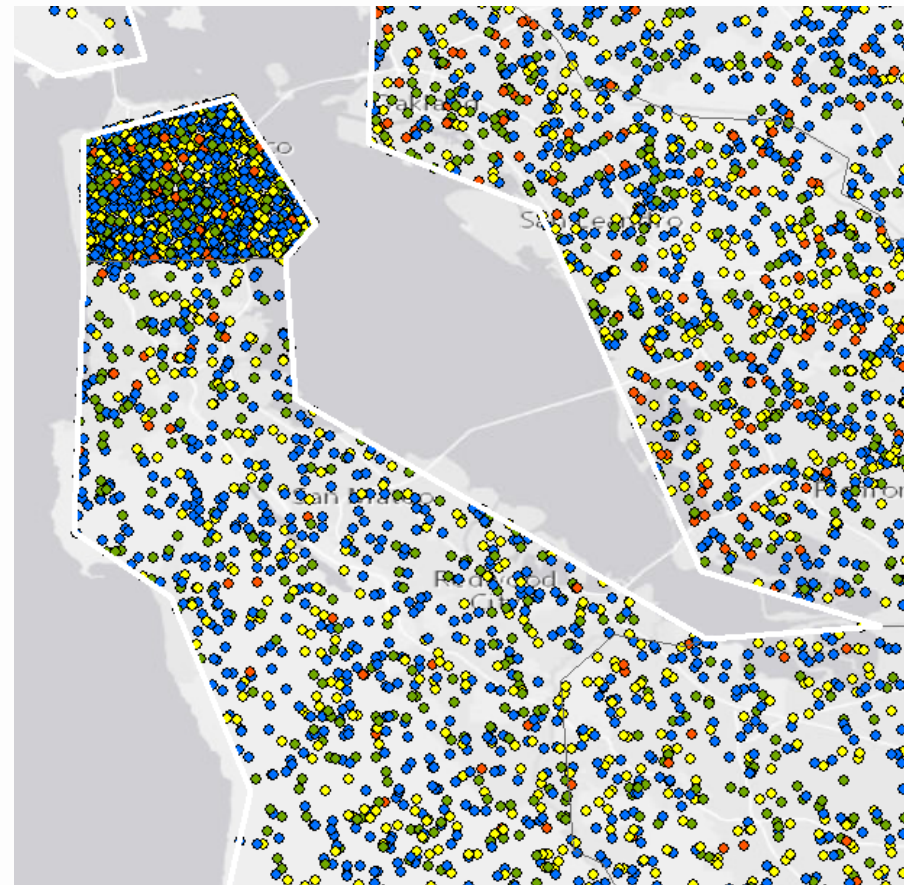
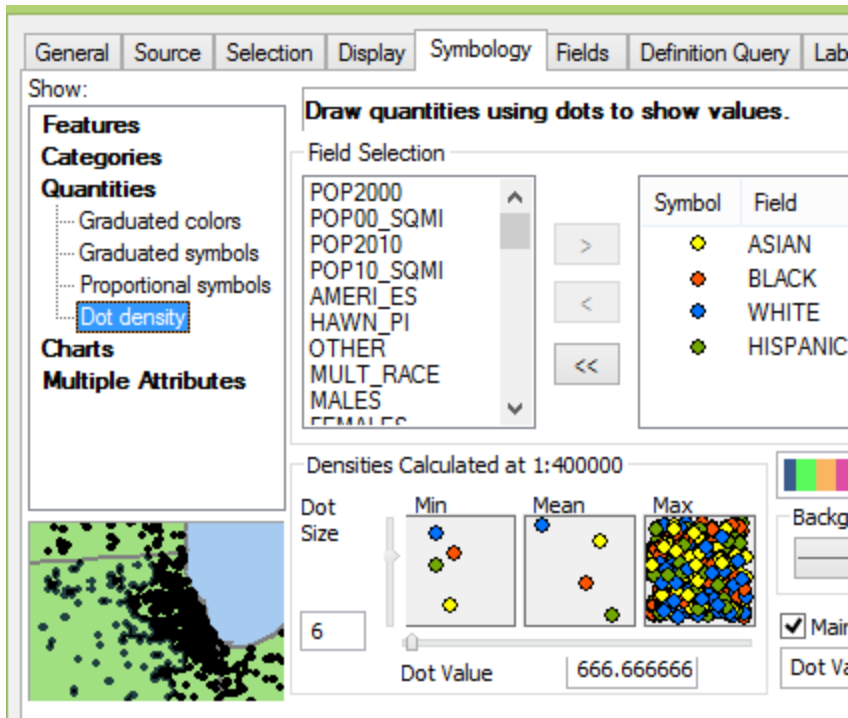
5

Styling the Map

Dot Map

[Polygon Data]

Properties > Symbology Tab > Quantities > Dot Density

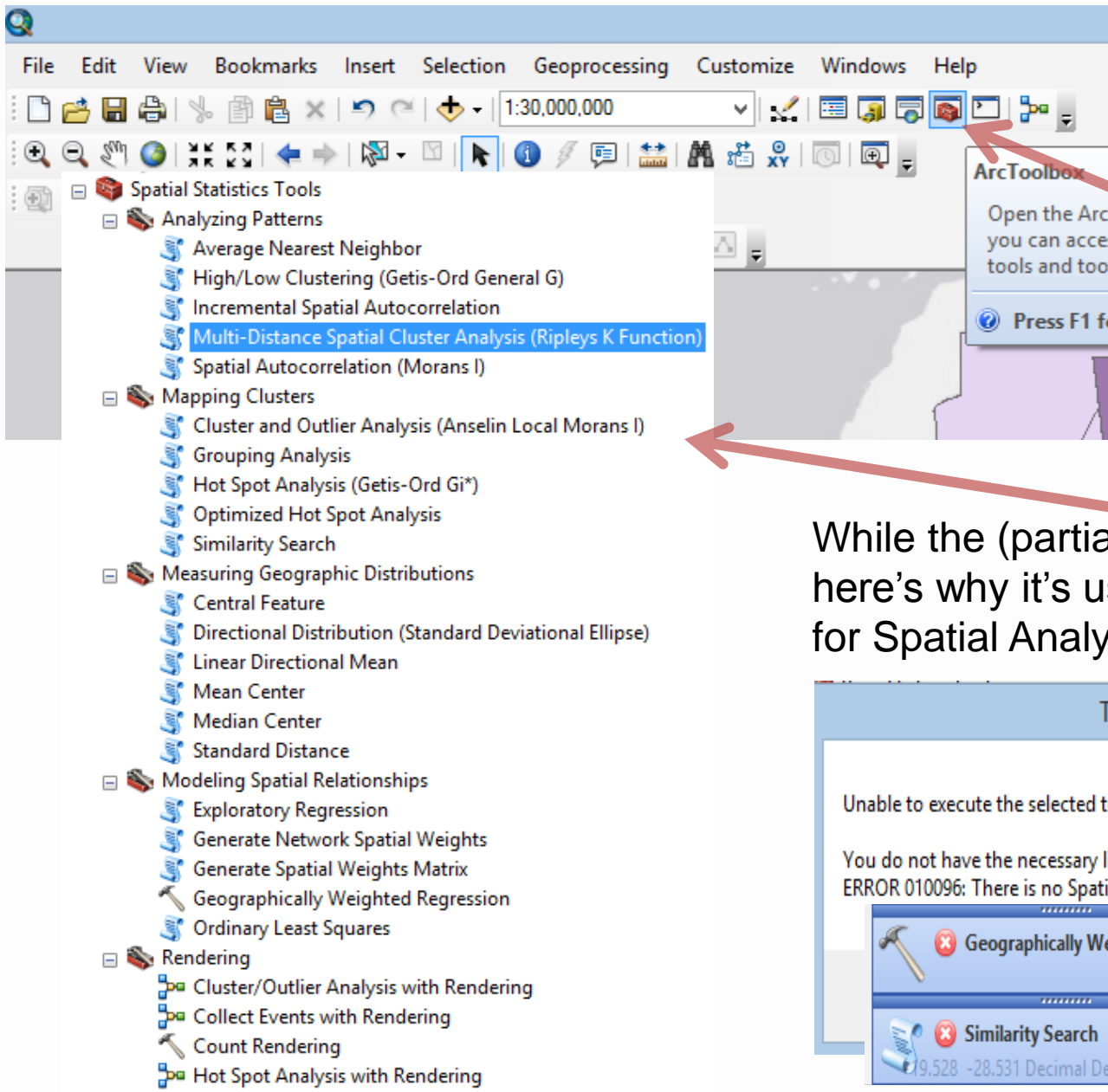


Using county-level race and population data
From the 2010 US Census.
***Within each county, dots of each color are evenly
spaced apart.

1 dot = 667 people

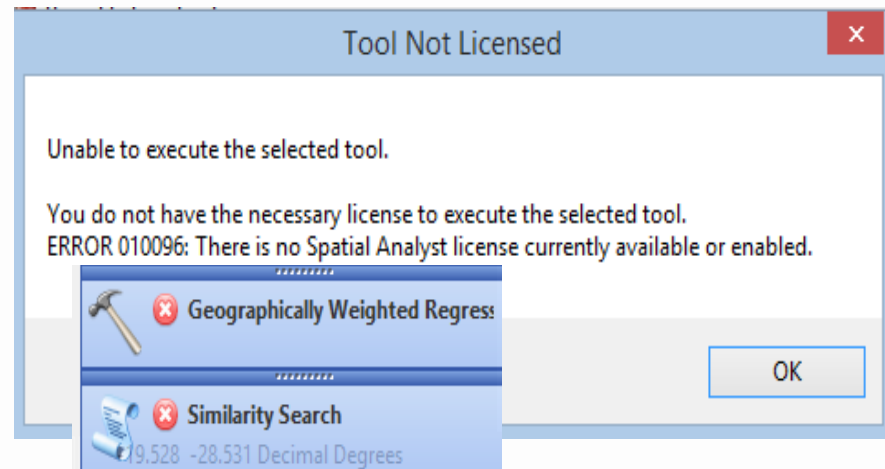
6

Spatial Analysis



ArcToolbox is where
You can browse through
The various tools

While the (partial) tool list is exciting,
here's why it's usually better to use R
for Spatial Analyses:

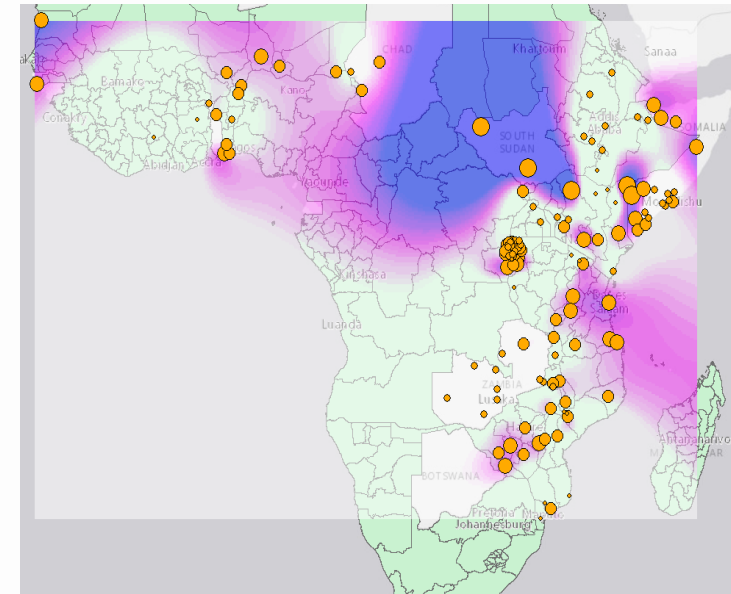


6

Spatial Analysis

*ArcToolBox > Interpolation > Splines w/ Barriers

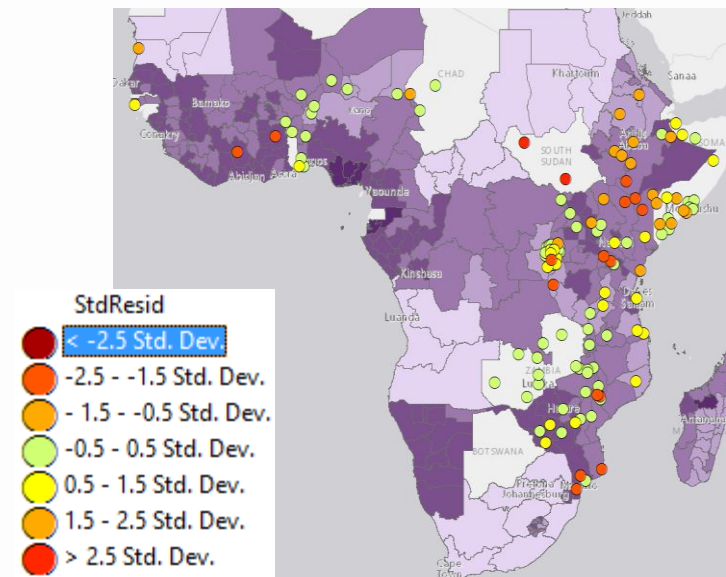
(in this case, we look at areas where maize prices that are higher than they “should” be, after adjusting for climate and fuel prices)



*ArcToolBox > Modeling Spatial Relationships > OLS

(in this case, our dependent var is Price/kilo of maize, and or predictor is precipitation. The colored points show standardized residuals.

The purple heat map indicates Child malnutrition)



7

Resources

Data Sources

Map of the world- Global Administrative Areas

<http://www.diva-gis.org/Data>

<http://www.gadm.org/version2>

Demographic Health Data (Used in Examples Here)

<http://spatialdata.dhsprogram.com/home/>

Stanford GIS Resouces

<https://lib.stanford.edu/gis>

Workshops

<https://lib.stanford.edu/gis>

Downloading ArcGIS

<https://lib.stanford.edu/gis>

US Census Data (Boundaries & Shapefiles)

https://www.census.gov/geo/maps-data/data/cbf/cbf_counties.html

Tutorials

Intro to python to make maps in ArcGIS (ArcPy)

http://www.esri.ca/sites/default/files/filemanager/Training_and_Events/Conference_Proceedings/2013/Winnipeg/Steven_Boothy_Winnipeg_2013.pdf

(Really good!) Free tutorials through ESRI <http://learn.arcgis.com/en/gallery/>

Other

<http://gis.stackexchange.com/>

<https://www.reddit.com/r/gis>