GIS I: Organizing Principles
Considering Spatial Data Exercise

*** Files needed for exercise: ***Louisiana.gdb, LA_tract_2017.shp,*** and ***LA_ACS2017_trt.dbf***

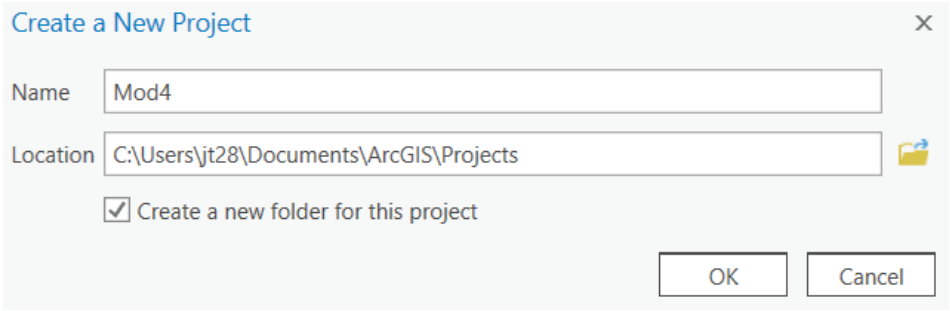
Goals: The goals for this exercise are to join a state of Louisiana US Census Tract shapefile to a dbf table containing tract level population data from the 2017 American Community Survey (ACS) 5 Year Estimates, and export the combined table to a new dataset. You will also gain experience sub-setting data using attribute queries and exporting data projected to the appropriate coordinate system.

Skills: After completing this exercise you will:

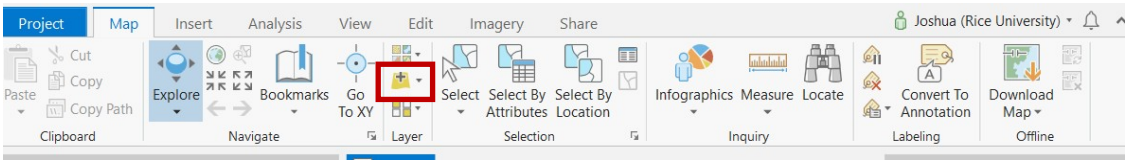
- Have some familiarity with common data formats used in GIS;
- Be able to execute a basic table join in ArcGIS Pro;
- Export data; and even
- Select features by attributes, create selection queries, change your selections, and access descriptive statistics for data in ArcGIS Pro.

Setting up your project and adding some contextual data

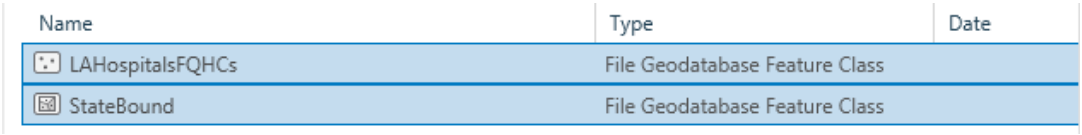
1. Open ArcGIS Pro. Choose a new Map from the **Blank Templates**.
2. Create a **New Project** and name it Mod4.



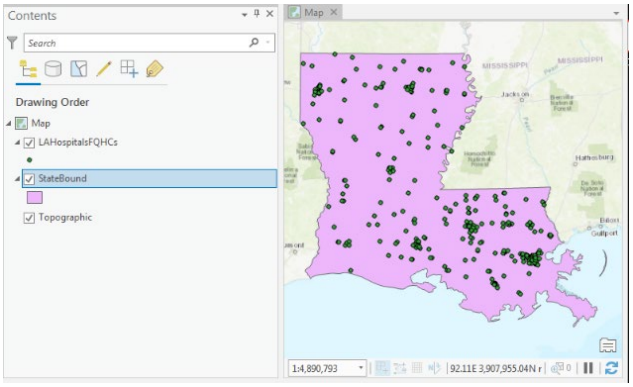
3. On the Map tab, Click the **Add Data** button.



4. Navigate to this module's exercise folder: Module4_Considering_Spatial_Data\ExerciseData and open it. Double click on the ***Louisiana.gdb;*** this is a file Geodatabase containing two feature classes add both of them to your map. You can select both by holding down the **Shift** key.

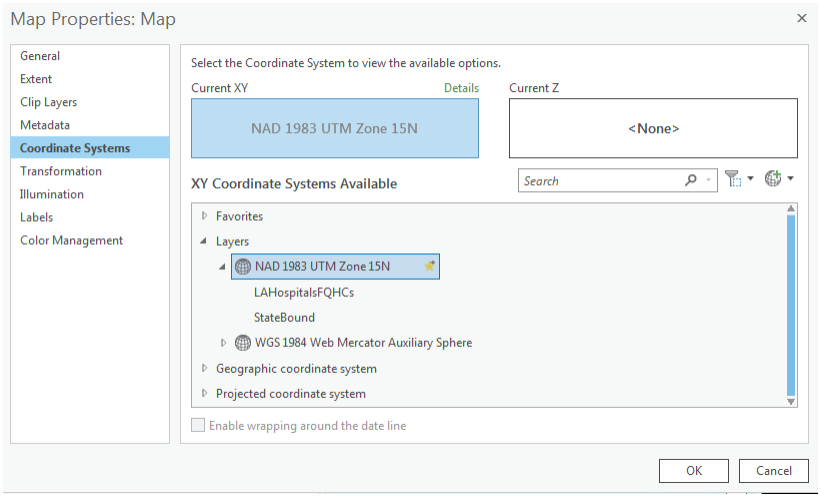


They will appear in your Map Contents:

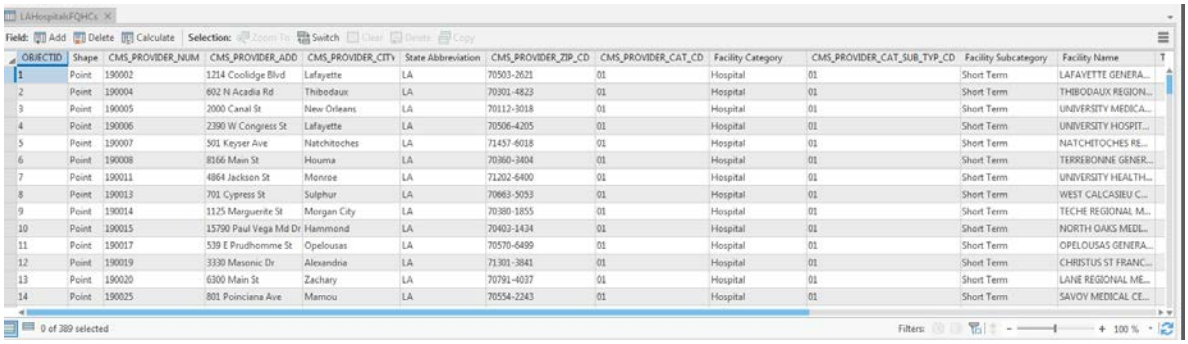


These include a point feature: ***LAHospitalsFQHCs*** (Hospitals and Federally Qualified Health Care Centers) and a polygon feature: ***StateBound***. Both of these features are projected to the state of Louisiana's projected coordinate system.

5. Right click on the word **Map** in **Contents** and select Properties>Coordinate Systems to view the coordinate system for your map. The two feature classes you added are projected to the state of LA's recommended system and have replaced the default, WGS 1984 Web Mercator Auxiliary Sphere.



6. Now right click on the *LAHospitalsFQHCs* feature and select **Attribute Table** to get a view of the table associated with this spatial data. Once you have finished, you may close the table.



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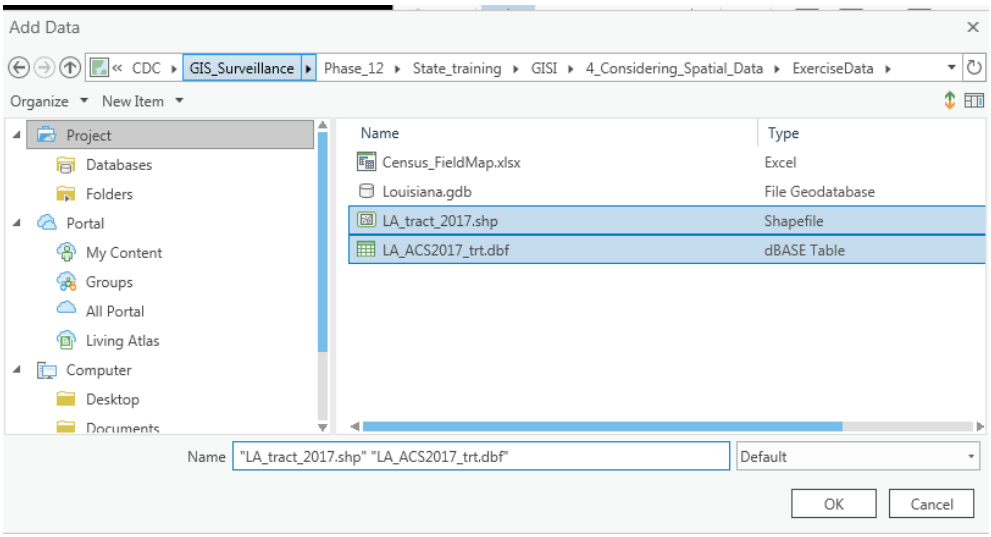
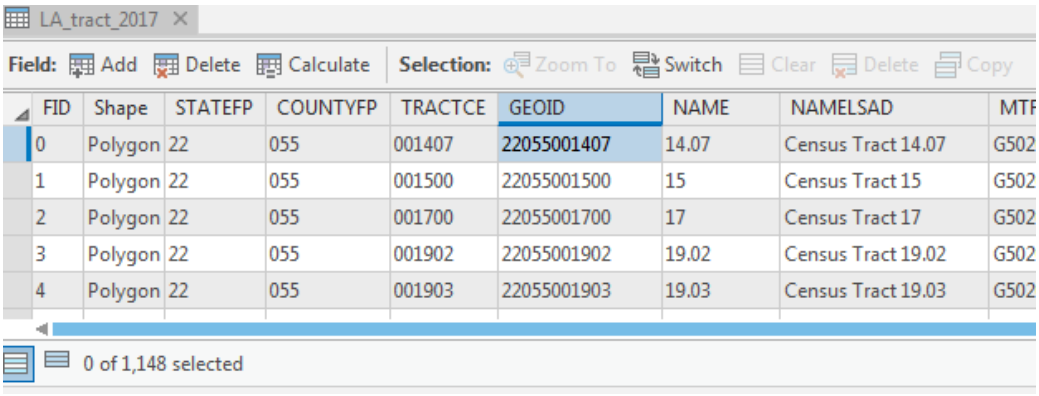
Understanding Tables and Preparing for a Table Join

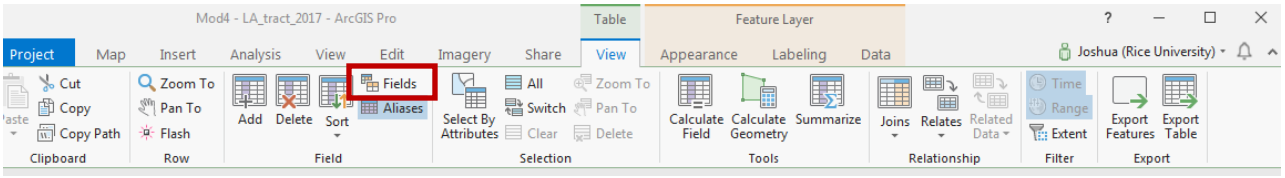
1. Next, you will add ***LA_tract_2017.shp,*** a polygon shapefile, and ***LA_ACS2017_trt.dbf,*** a table of select American Community Survey (ACS) data at the US Census tract level.

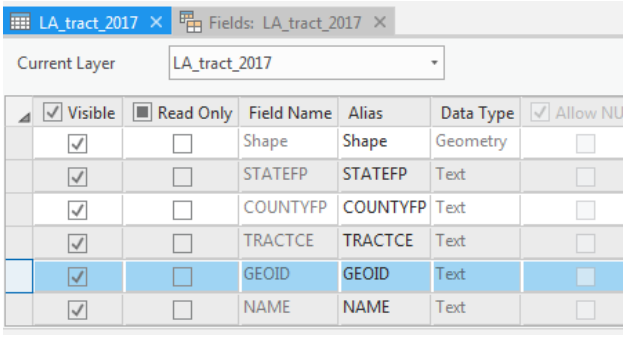


2. You will append the ACS data to the tract shapefile, ***LA_tract_2017.shp,*** attribute table – *this is the **target** table*.
3. Take a look at the fields in your tract shapefile attribute table. To view the attribute table, right click on the shapefile in the **Contents** and select **Attribute Table**.
4. This table is associated with your tract shapefile with attribute names (attribute fields) as columns and rows as records of individual tracts. At the bottom of the table, the number of records is shown.
5. The join will be based on the **GEOID** attribute field; this field represents the tract identifier code. Is this field unique to each tract?



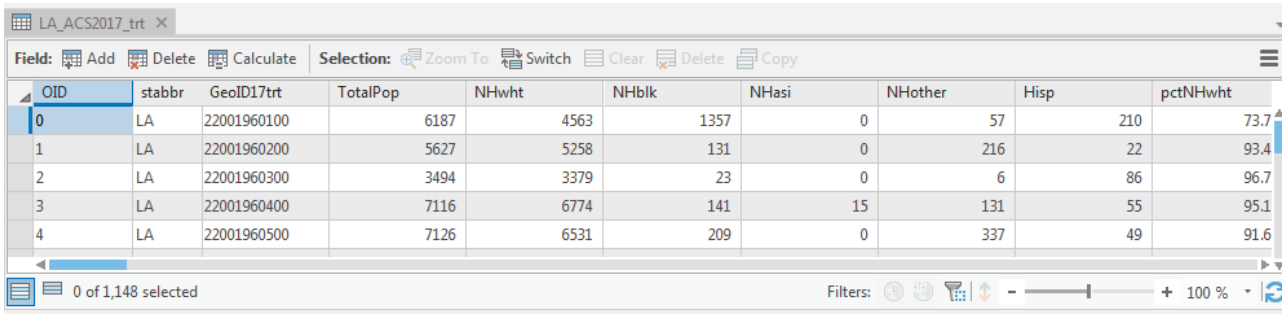
6. This field is in fact unique and represents 1 tract. You should determine what type of data field it is. To find this information, right click on the shapefile in your Contents and open its attribute table. Then select Fields under the Table tab in the top ribbon. This will open the **Fields** tab. Click the **GEOID** field. What type of field is it?





Do you know what a* GEOID *code is? *This field represents an eleven-digit code which uniquely identifies a US Census Tract. The first two digits are the state code, the next three the county code, and the final six the tract identifier: together they ID a single US Census tract.*

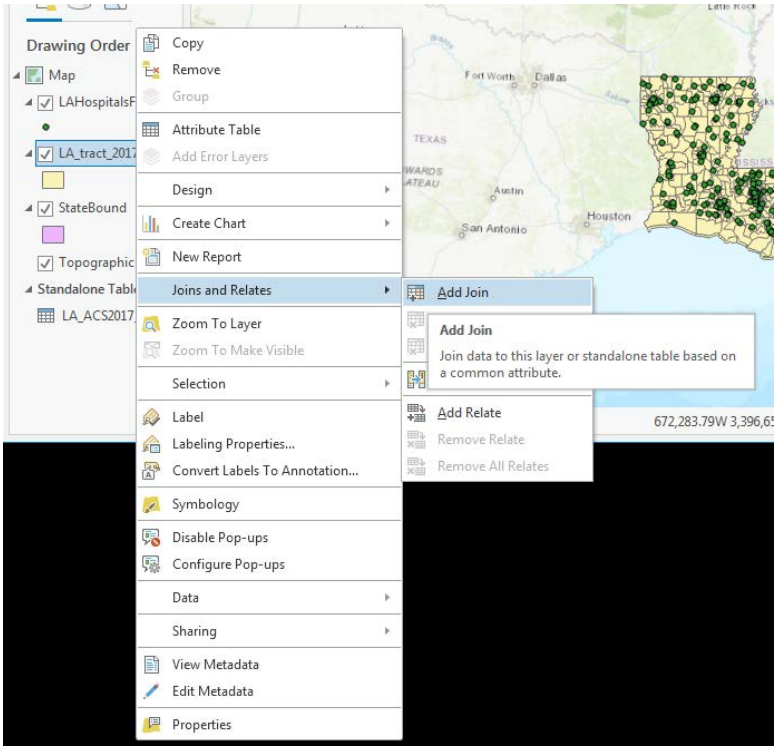
7. Now that you know more about your target table, take a look at the table you will append to: the tract shapefile (***LA_ACS2017_trt.dbf***) - *this is the* ***join*** *table*. Open this table and examine it; the common field that you will use to join this table to your shapefile is: ***GeoID17trt.*** Confirm that it is the same data type as the field in the tract shapefile.



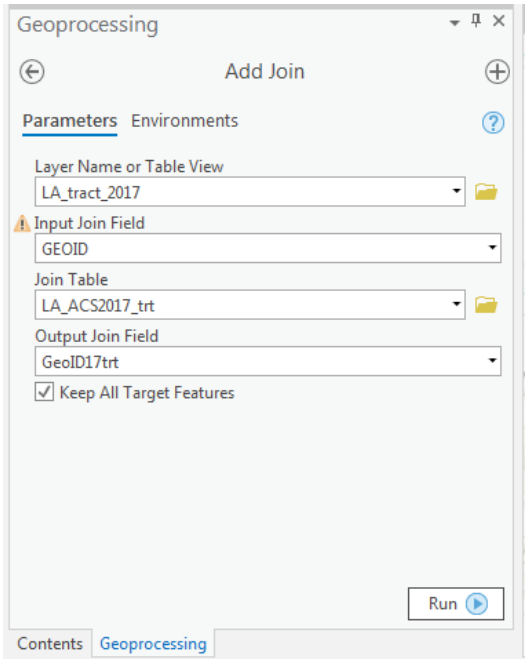
OID	stabbr	GeoID17trt	TotalPop	NHwht	NHblk	NHasi	NHother	Hisp	pctNHwht
0	LA	22001960100	6187	4563	1357	0	57	210	73.7
1	LA	22001960200	5627	5258	131	0	216	22	93.4
2	LA	22001960300	3494	3379	23	0	6	86	96.7
3	LA	22001960400	7116	6774	141	15	131	55	95.1
4	LA	22001960500	7126	6531	209	0	337	49	91.6

Performing a Table Join

1. In examining your two tables you may have noticed that there are the same number of records in both your target and join tables, this means for every record in your target table we expect 1 matching record in the join table.
2. You have confirmed that the field you are basing your join on is a *common field* to both the target table (***LA_tract_2017.shp*** "**GEOID**"), and the join table (***LA_ACS2017_trt.dbf*** "***GeoID17trt***"). In this case, the two fields do not have the same name in each table, but more importantly, they do have the same meaning and are of the same data type, so you are ready to join.
3. Right click on the ***LA_tract_2017.shp*** in the Contents; select the **Joins and Relates**; choose **Add Join**. This will open the Join Data dialogue.



4. First, you will choose the join field in your target table that the join will be based on: **GEOID**.
5. Select the ***LA_ACS2017_trt*** table as the table to join to your target.
6. Finally, choose the field in the join table to base the join on: ***GeoID17trt***.
7. Click **Run** to execute the join**.**



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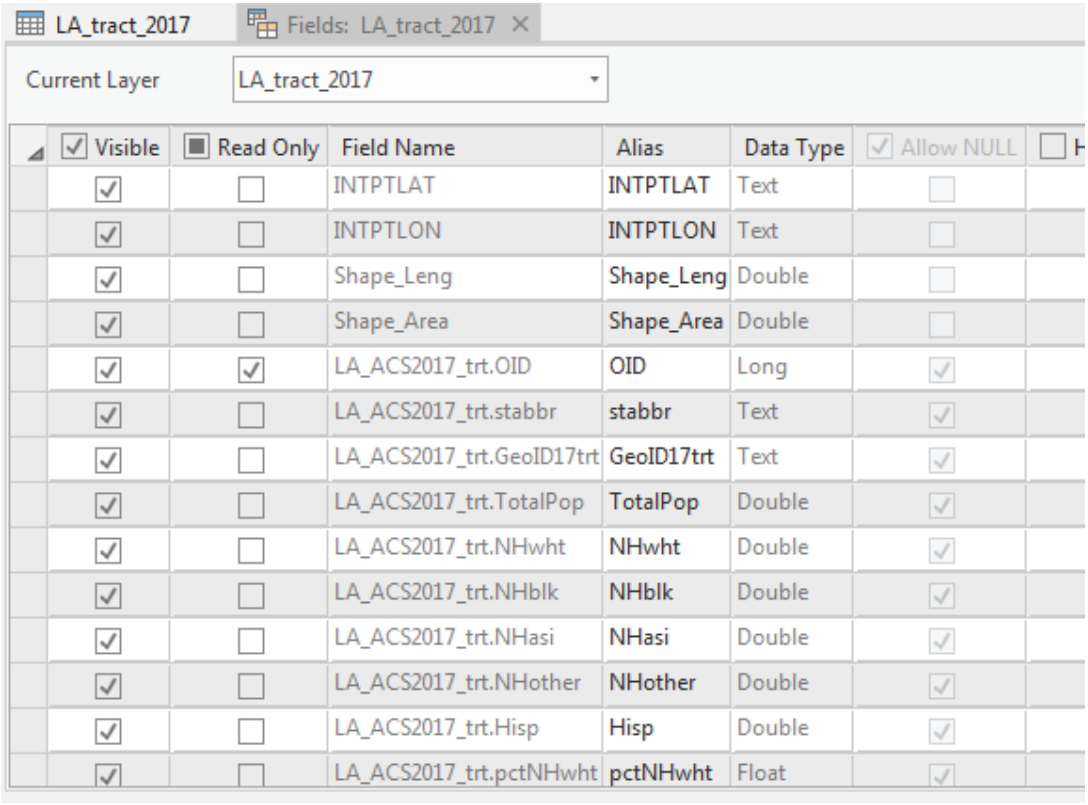
Examining the Result of a Table Join

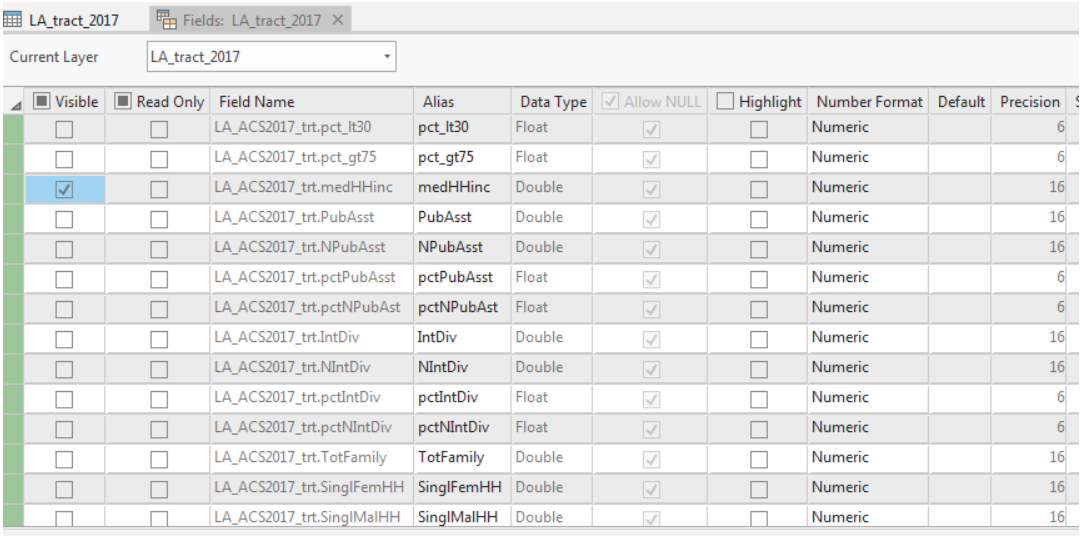
1. Right click on your target (***LA_tract_2017.shp***) in the Contents and open the attribute table.
    a. Does the table look different? The **Shape_Area** field is the last field of your target table ***LA_tract_2017.shp***. Every field to the right has been added from the join table ***LA_ACS2017_trt.dbf.***
2. Check your **Fields** this time by right clicking on a field name in the open attribute table. All fields from both tables (target/join) should be present.



Visible	Read Only	Field Name	Alias	Data Type	Allow NULL
☑	☐	INTPTLAT	INTPTLAT	Text	☐
☑	☐	INTPTLON	INTPTLON	Text	☐
☑	☐	Shape_Leng	Shape_Leng	Double	☐
☑	☐	Shape_Area	Shape_Area	Double	☐
☑	☑	LA_ACS2017_trt.OID	OID	Long	☑
☑	☐	LA_ACS2017_trt.stabbr	stabbr	Text	☑
☑	☐	LA_ACS2017_trt.GeoID17trt	GeoID17trt	Text	☑
☑	☐	LA_ACS2017_trt.TotalPop	TotalPop	Double	☑
☑	☐	LA_ACS2017_trt.NHwht	NHwht	Double	☑
☑	☐	LA_ACS2017_trt.NHblk	NHblk	Double	☑
☑	☐	LA_ACS2017_trt.NHasi	NHasi	Double	☑
☑	☐	LA_ACS2017_trt.NHother	NHother	Double	☑
☑	☐	LA_ACS2017_trt.Hisp	Hisp	Double	☑
☑	☐	LA_ACS2017_trt.pctNHwht	pctNHwht	Float	☑

3. A successful table join is very useful. You can select, display, or calculate fields based on the appended data in the target table.
4. It is important to remember that in a join the data are dynamically linked: what does this mean?
    a. Nothing is written on disk - the join exists in your project only.
    b. Edits to the underlying tables will appear in appended fields.
    c. Fields in your target table can be edited, but the data in the appended fields **cannot** be directly edited.
5. You will now export your joined data (target + join) to a new feature in the ***Louisiana.gdb***. The table associated with this new feature will include all of the data from the two original tables, and will be written on disk - so you will need to name and save it.
6. Before you export your joined data, you can select the fields that you want to be present in your new feature class.

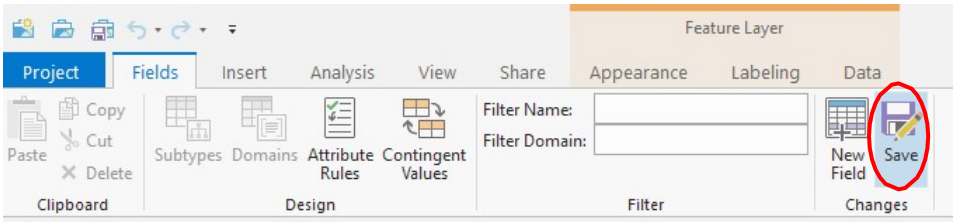
7. Uncheck **Visible** to turn all fields off and choose the following five fields by checking their boxes:
    - GEOID
    - TotalPop
    - pct_ltHS
    - pct_Unempl
    - medHHinc



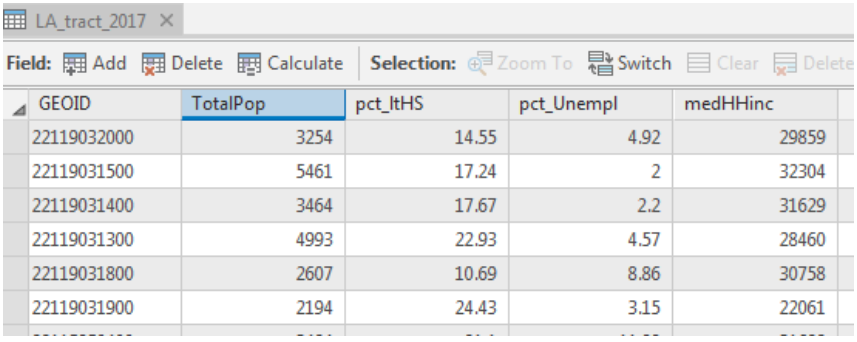
Visible	Read Only	Field Name	Alias	Data Type	Allow NULL	Highlight	Number Format	Default	Precision
☐	☐	LA_ACS2017_trt.pct_lt30	pct_lt30	Float	☑	☐	Numeric		6
☐	☐	LA_ACS2017_trt.pct_gt75	pct_gt75	Float	☑	☐	Numeric		6
☑	☐	LA_ACS2017_trt.medHHinc	medHHinc	Double	☑	☐	Numeric		16
☐	☐	LA_ACS2017_trt.PubAsst	PubAsst	Double	☑	☐	Numeric		16
☐	☐	LA_ACS2017_trt.NPubAsst	NPubAsst	Double	☑	☐	Numeric		16
☐	☐	LA_ACS2017_trt.pctPubAsst	pctPubAsst	Float	☑	☐	Numeric		6
☐	☐	LA_ACS2017_trt.pctNPubAst	pctNPubAst	Float	☑	☐	Numeric		6
☐	☐	LA_ACS2017_trt.IntDiv	IntDiv	Double	☑	☐	Numeric		16
☐	☐	LA_ACS2017_trt.NIntDiv	NIntDiv	Double	☑	☐	Numeric		16
☐	☐	LA_ACS2017_trt.pctIntDiv	pctIntDiv	Float	☑	☐	Numeric		6
☐	☐	LA_ACS2017_trt.pctNIntDiv	pctNIntDiv	Float	☑	☐	Numeric		6
☐	☐	LA_ACS2017_trt.TotFamily	TotFamily	Double	☑	☐	Numeric		16
☐	☐	LA_ACS2017_trt.SinglFemHH	SinglFemHH	Double	☑	☐	Numeric		16
☐	☐	LA_ACS2017_trt.SinglMalHH	SinglMalHH	Double	☑	☐	Numeric		16

NOTE: these standard ACS and Census variables and others provided over the course of the training are defined here in the Census_FieldMap.xlsx file which is posted in the GIS I training materials folder on Box.

8. After making these changes, be sure to click **Save** on the fields tab.

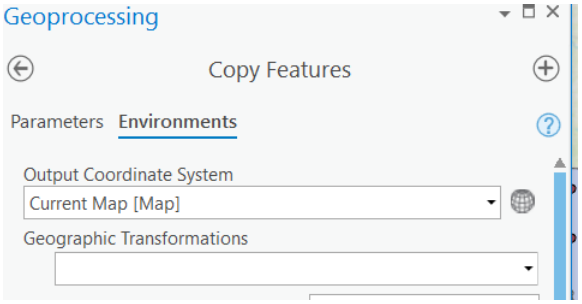


9. Take a look at your attribute table. The five fields you selected should be the only fields you see in the table.

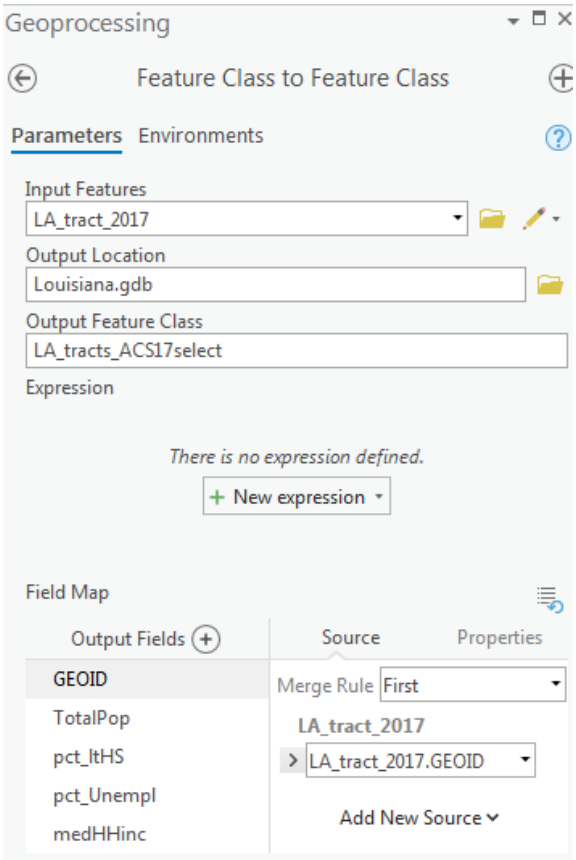


GEOID	TotalPop	pct_ltHS	pct_Unempl	medHHinc
22119032000	3254	14.55	4.92	29859
22119031500	5461	17.24	2	32304
22119031400	3464	17.67	2.2	31629
22119031300	4993	22.93	4.57	28460
22119031800	2607	10.69	8.86	30758
22119031900	2194	24.43	3.15	22061

10. Create a new feature class within the LA Geodatabase. Close your table and right click on ***LA_tract_2017.shp*** in your contents one last time. Choose **Data > Export Features** to open the **Copy Features** tool in the right pane. In the **Environments tab**, use the same coordinate system as the **Current Map [Map].**



In the **Parameters tab**, under Output Feature Class, click the folder browse button and navigate to the ***Louisiana.gdb*** and name the output feature class ***LA_tracts_ACS17select***. Select **Run** complete the export.



11. At this point, you no longer need the original .dbf file, nor the original tract shapefile. Right click on each in the **Contents** and **Remove** them.
12. Now that you have added the exported data as a new layer, take a look at the attribute table. Only the fields you selected should be present in the resultant feature class

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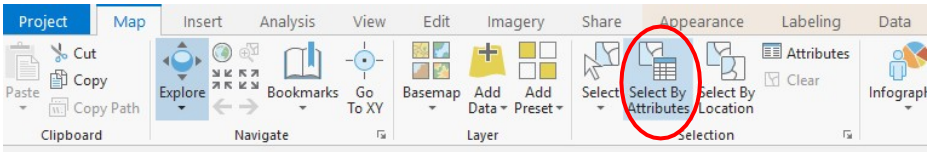
Working with Selections

1. Open the attribute table for your new feature class. In the Map tab, choose: **Select by attributes**. You can control the options for your selections in this menu and you can build your attribute selections. You will now make a selection based on your joined fields.

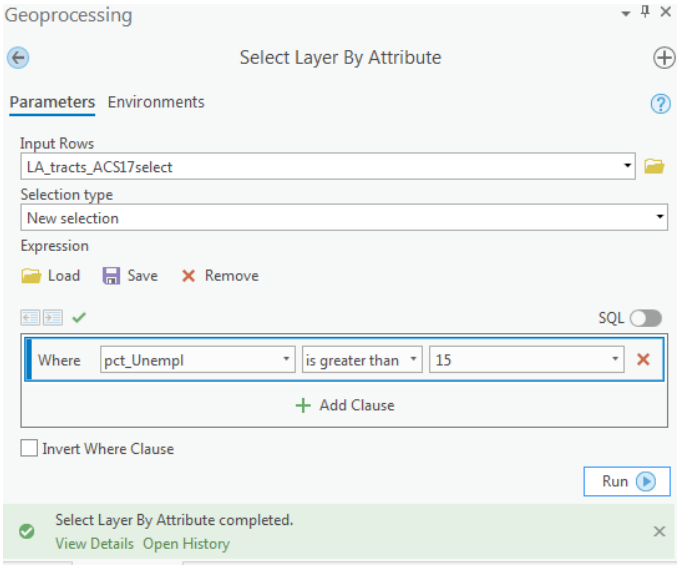


2. In the Parameters tab, select the *LA_tracts_ACS17select* as your *Input Rows* and select **New selection** as Selection type. Click on the Add Clause and enter the following:

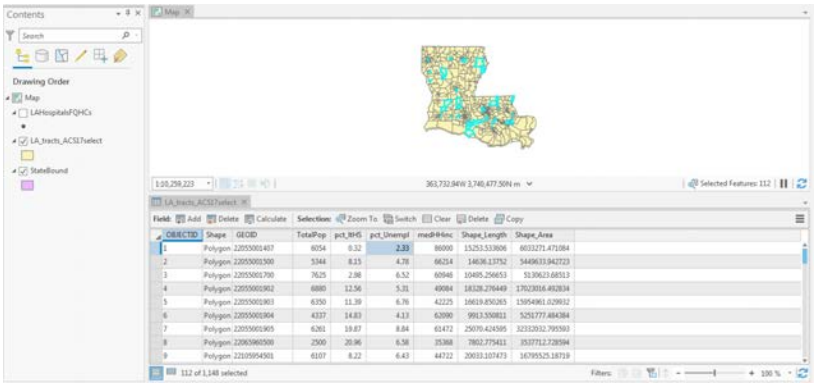
   "pct_Unempl") is ***greater than 15***

   (the national unemployment rate is ~3.5% https://www.bls.gov/news.release/pdf/empsit.pdf)

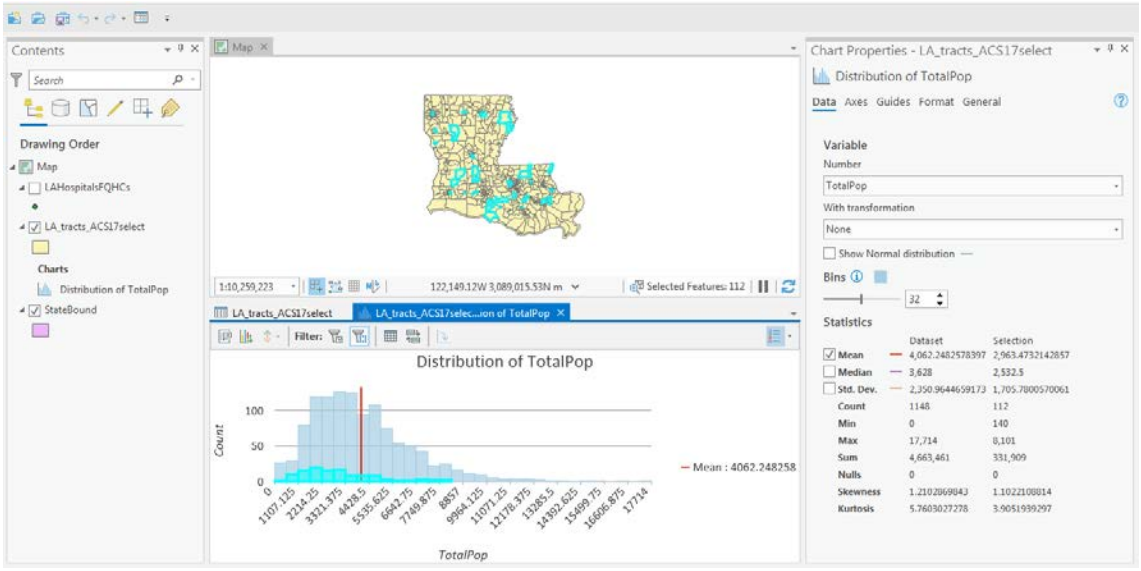
   Be sure to click **add**. This query will select those tracts that have more than 15% unemployment. Click **Run**.



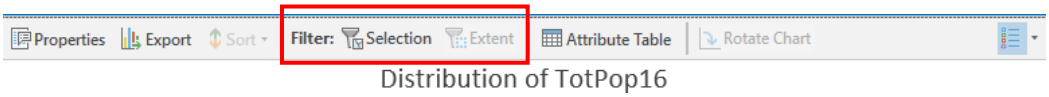
3. Take a look at the tracts that are selected in your table and also on the map (you may need to zoom in to see these)



4. You are now going to take a look at some descriptive statistics for your selected records. Open up the attribute table and right click on the “TotalPop” field. Select **Statistics**.



5. Here you can access summary statistics for any meaningful attributes within your selection and the complete data by toggling between filter tabs: selection and extent.



6. What is the total population for tracts with unemployment over 15%? Looks like 331,909 according to the 2017 ACS (or ~7% of the state’s population).
7. Right click on your ***LA_tracts_ACS17select*** feature in the Contents and choose **Selection**. In this menu you can:
    - Zoom to selected features;
    - Clear selected features;
    - Copy selected;
    - Switch selection and;
    - Create a layer from selected features.
8. Choose **Switch Selection.** This will select all of the tracts that have less than 15% unemployment.
9. Take a look at the Statistics for TotalPop with your new Selection.