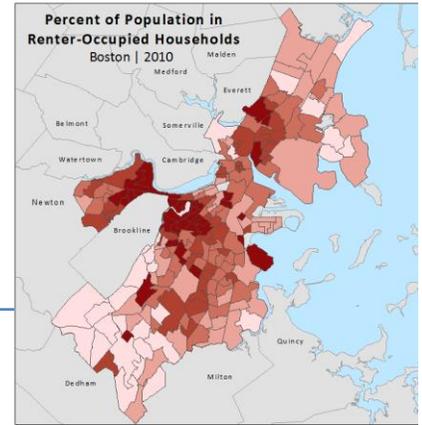


USA Census Tutorial: Downloading & Mapping American Factfinder Census Data on Renter Demographics for use in ArcMap

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Skills covered in this tutorial include:

- Obtaining excel data from the American Fact Finder on Census.Gov
- Obtaining Geography Data from census.gov
- Cleaning Excel Data for Joins
- Joining Excel Data in ArcMap

In this tutorial, we will be obtaining information about housing tenure at the **Census Tract** level from the **2010 Census** for a single county using American Factfinder. You can then use a similar process to download any other Census 2010, American Community Survey, or Census 2000 data for other geography levels and/or for whole states or multiple counties. You have many, many options in American Factfinder – this shows one possible path.

Obtaining GIS Files from Census Geography

The first step is to download the administrative geography spatial data (shapefiles) from Census.gov. This is the GIS data and contains only the boundary data – there is no demographic information included.

1. Data management is critical when dealing with the multiple tables of the Census. Before beginning this tutorial:
 - a. Create a “**Census_2010**” folder in your personal workspace (H drive).
 - b. Create *two* subfolders: **AFF_Data** and **Census_Geography**
 - The AFF folder will hold the excel tables you download from the Census

- The Geography folder will hold the actual GIS Data shapefiles

2. Go to the Census web site (<http://census.gov>) and click **Browse by Topic** and then the **Geography** link.



3. Under **Maps and Data**, select **TIGER Products**.
Maps & Data

TIGER Products

Spatial extracts for use in GIS software from the MAF/TIGER database, containing features such as roads, rivers, and legal and statistical geographic areas.

4. Then click on **Tiger/Line Shapefiles** in the **Table** as shown:

Which product should I use?

Product	Best Use
TIGER/Line Shapefiles	Most mapping projects--this is our <i>most</i> used product with GIS (geographic information system) software.
TIGER Geodatabases	Useful for users needing national datasets. Designed for use in ArcGIS. Files are available in a compressed format.

5. Click on **2017** and expand **Download** tab. Then click on **Web Interface**.

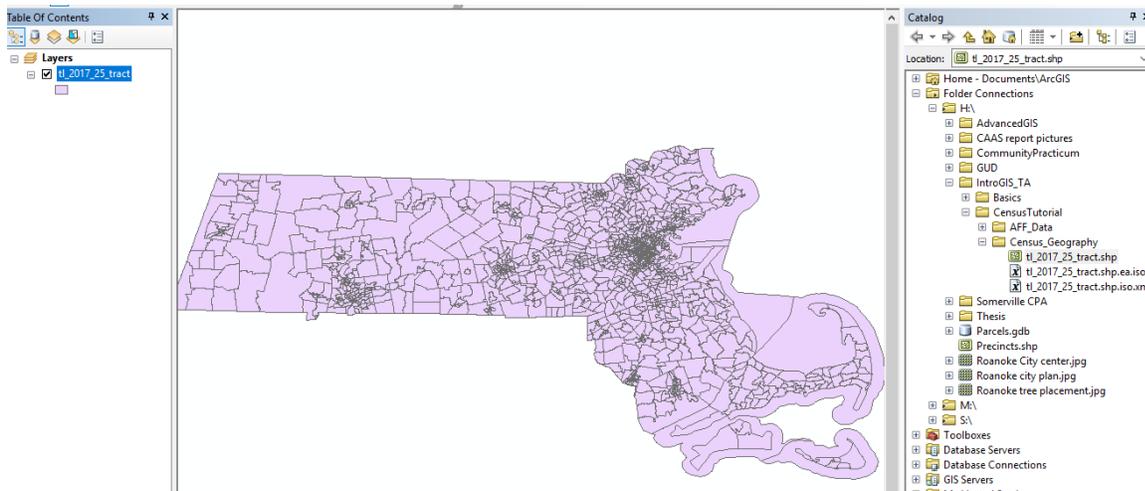
The screenshot shows the '2017 TIGER/Line Shapefiles' page. At the top, there are navigation tabs for years from 2017 to 2011, and 'Census 2000' and '1992'. Below the tabs, the page title is '2017 TIGER/Line Shapefiles' with a subtitle 'All legal boundaries and names are as of January 1, 2017. Release date: 2017-08-14'. A green 'Download' button is visible. Below it, a list of download options includes 'Web interface' (highlighted with a yellow box and a mouse cursor) and 'FTP site'. Further down, there are expandable sections for 'Technical Documentation', 'File Availability', and 'User Notes'. At the bottom, a disclaimer states: 'The boundaries shown are for Census Bureau statistical data collection purposes and do not constitute a determination of jurisdiction.'

- Under **Select Year**, choose 2017 and under **Select a Layer Type**, notice how many different types of GIS data you can download from here! Remember this site!! Choose **Census Tracts** then **Submit**.

Select year

Select a layer type

- Select your **state of interest** (this tutorial will use Massachusetts data, but feel free to try it with your own area of interest if you wish!) and click **download**. It downloads the data as a zipped file.
- Save the zip file into the **Census_Geography** folder in your H drive. Navigate to the folder (in windows) and right click on the zipped file. Select *extract here*.
- Open a **blank ArcMap session** and navigate to that folder in Catalog. Drag in this new shapefile from your H drive. If you already had ArcMap open, you'll likely have to refresh your H drive folder.



- Change the name of the layer in the Table of Contents from `tl_2017_25_tract` to **Census Tracts**. The census naming system for this particular files works as such: `tl` = tiger, 2017 is the year the data represents, 25 is the state number – aka Mass, and Tract is the unit of the administrative boundary.

Remember: Census tracts are created to have approximately 4000 people per census tract – that is why they are varying sizes across the state.

Obtaining Data from American FactFinder (AFF)

Now we need to go and get the excel data containing all the demographic data per census tract.

- Go to the US Census web site – <http://census.gov>
- Click on the **Data** tab → **Data Tools & Apps** → select **American FactFinder**. This is the web interface to access census **excel/tabular data**.

BROWSE BY TOPIC	EXPLORE DATA	LIBRARY	SURVEYS/ PROGRAMS	INFORMATION FOR...	FIND A CODE	ABOUT US
Explore Data Main		Related Sites				
Census Academy		Software				
Combining Data		Tables				
Data Tools and Apps		Training and Workshops				
Developers		Visualizations				

Data

- Census Academy
- Combining Data
- Data Tools and Apps**
- Developers
- Infographics & Visualizations
- Related Sites
- Software
- Tables
- Training & Workshops

Data Tools and Apps

Find information using interactive applications to get statistics from multiple surveys.

Page 1 of 0 >

Access Tools at Other Sites: Integrated Public Use Microdata Series

iPUMS USA collects, preserves and harmonizes U.S. Census Bureau microdata and provides easy access to this data with enhanced documentation.

American FactFinder (AFF)

This interactive application provides statistics from the Economic Census, the American Community Survey, and the 2010 Census, among others.



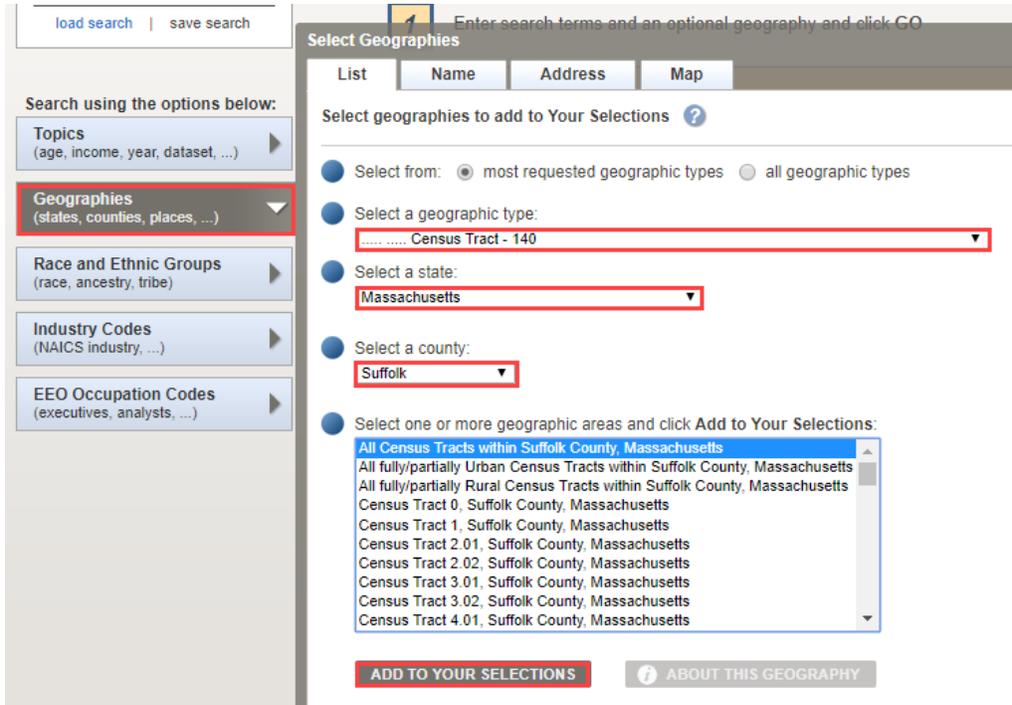
3. Click on **Advanced Search** and select **Show Me All**.

- ▶ **Community Facts**
- ▶ **Guided Search**
- ▼ **Advanced Search**
Search all data in American FactFinder, with access to all geographic types and datasets.
- ▶ **Download Center**

SHOW ME ALL

4. Click on **Geographies** in the left column – this brings up the *Select Geographies overlay*. This is where we tell it to get Mass data ONLY by census tract! Once we set this search selection, the census website will only give us data that is available for this location and *scale*.

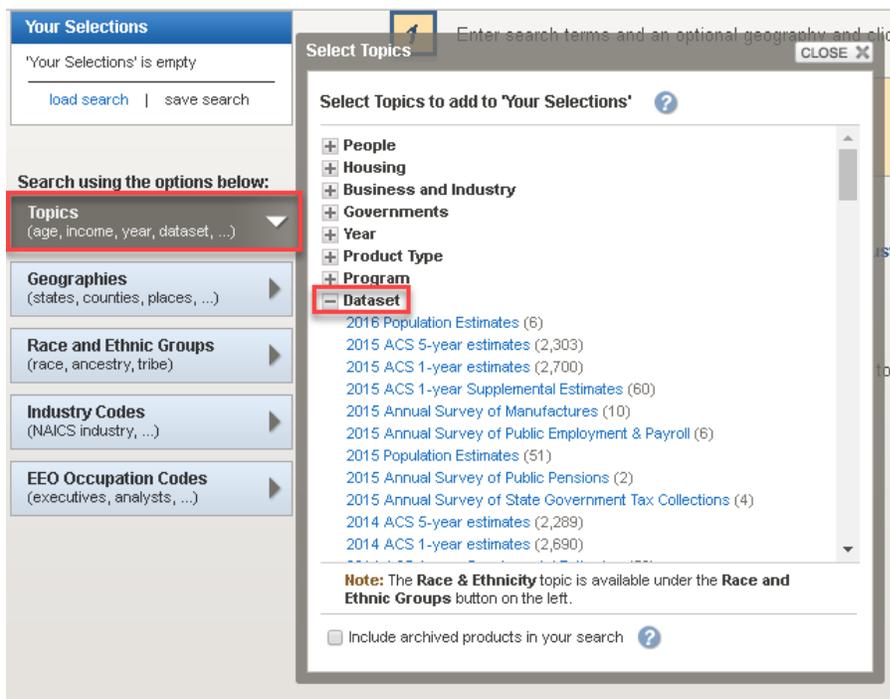
- Fill out the box so that you are selecting **Census Tracts** for a specific state and a county in that state. You can follow the example below if you want to select all census tracts in Suffolk County, Massachusetts. Alternatively, you could pick a state and county of your choosing.



- Be sure to click on **ADD TO YOUR SELECTIONS**.



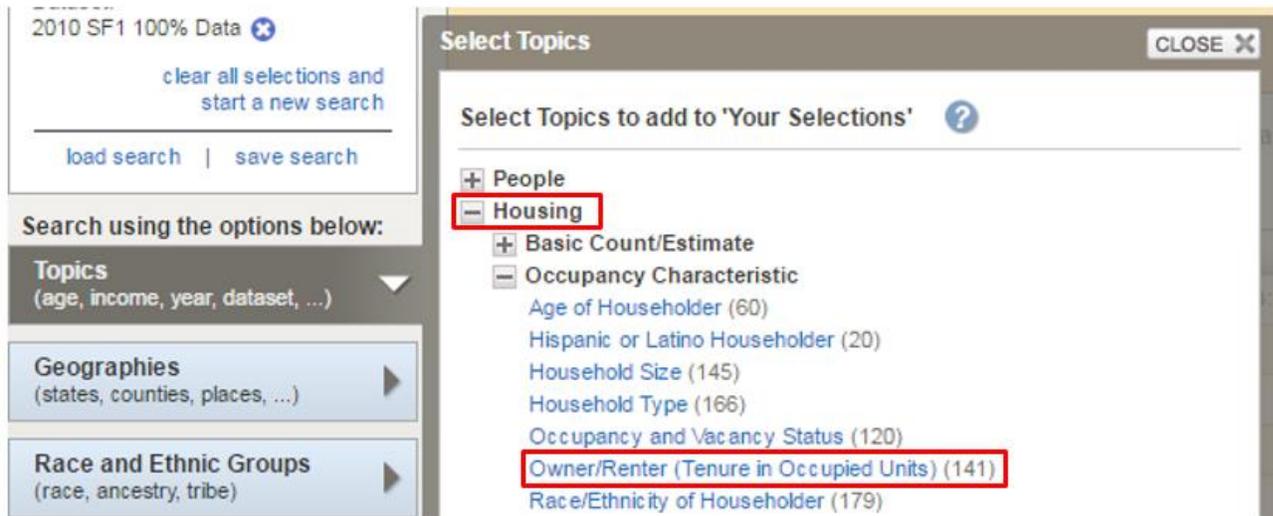
- Close the Select Geographies overlay by clicking in the top right corner of the box.
- Now that you told it where you want the data, you need to tell it **WHAT** data you want to download. Today, you'll be downloading information on Housing and Tenure.
- Click on **Topics** in the left column and expand **Dataset**.



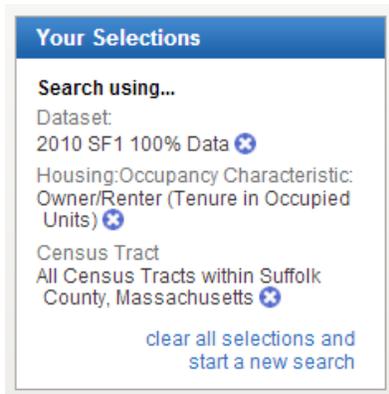
10. Scroll down to click on **2010 SF1 100% Data** – this will send this criteria to your Selection box in the upper left of the site:



11. Scroll up in the **Topics** list and click on **Housing**. Then, under **Occupancy Characteristic**, click on **Owner/Renter (Tenure in Occupied Units)**.



12. Close the **Topics** box by clicking in the top right corner of the box.
13. Be sure that the **Your Selections** box in the upper left corner contains what you want – the data set, the general topic, and the census geography level for the specific location you want (all tracts, not just one tract). If it does not say this, clear your selections and start over from Step 4 above.



14. You should now have a list of available datasets about housing characteristics. **Checkmark** one of interest and see what variables it contains by clicking on the *Information* icon for that table. This pulls up the information about this table. You'll see what data will be included when you download it. This is very helpful for previewing datasets so you don't have to go through all the steps of downloading it first. For this exercise, we highly recommend a table with just a few variables. In this exercise, we have used the **H11 table for total population in occupied housing**.

15. After checking a table, click on **Download** ( **Download**) and follow the instructions. This creates a zip file. Save it in your *Census_2010* → *AFF Data* folder.

16. Navigate to your AFF folder. Right click on the zipped folder and select *extract here* or open with Power Archiver and extract to AFF folder.

Preparing American FactFinder Data for Use in ArcMap

1. You'll notice that 2 csv files have downloaded, along with two txt files. Double-click on both downloaded **CSV** files to open them:

 aff_download.zip	1/19/2018 11:15 AM	PowerArchiver ZIP...	6 KB
 aff_download_readme_ann.txt	1/19/2018 11:14 AM	Text Document	2 KB
 DEC_10_SF1_H11.txt	1/19/2018 11:14 AM	Text Document	1 KB
 DEC_10_SF1_H11_metadata.csv	1/19/2018 11:14 AM	Microsoft Excel C...	1 KB
 DEC_10_SF1_H11_with_ann.csv	1/19/2018 11:14 AM	Microsoft Excel C...	21 KB

Several files will be downloaded. The “with_ann” file contains the data, while the “metadata” file contains the descriptions of the table headings. Open both excel files. Note: If you are opening the file from within Excel, you will need to set the option to look for all file types

Note: If you are opening the file from within Excel, you will need to set the option to look for *all file types*:

2. The “DEC_10...with_ann” file should look something like this.

	A1							
	A	B	C	D	E	F	G	H
1	GEO.id	GEO.id2	GEO.displ	D001	D002	D003	D004	
2	Id	Id2	Geograph	Total popi	Owned wi	Owned fre	Renter occupie	
3	1400000U!	2.5E+10	Census Tr	4225(r338:	794	231	3200	
4	1400000U!	2.5E+10	Census Tr	3730(r338:	828	262	2640	
5	1400000U!	2.5E+10	Census Tr	3861	857	349	2655	
6	1400000U!	2.5E+10	Census Tr	2628	799	270	1559	
7	1400000U!	2.5E+10	Census Tr	2916	941	413	1562	
8	1400000U!	2.5E+10	Census Tr	5672	851	281	4540	
9	1400000U!	2.5E+10	Census Tr	3511	868	297	2346	
10	1400000U!	2.5E+10	Census Tr	3110	447	154	2509	
11	1400000U!	2.5E+10	Census Tr	2211	444	81	1686	
12	1400000U!	2.5E+10	Census Tr	4915	682	187	4046	
13	1400000U!	2.5E+10	Census Tr	3371	818	248	2305	
14	1400000U!	2.5E+10	Census Tr	3974	264	107	3603	
15	1400000U!	2.5E+10	Census Tr	4397	474	150	3773	
16	1400000U!	2.5E+10	Census Tr	2619	90	25	2504	
17	1400000U!	2.5E+10	Census Tr	4794	447	154	4193	
18	1400000U!	2.5E+10	Census Tr	7869	907	316	6646	
19	1400000U!	2.5E+10	Census Tr	1601	11	6	1584	
20	1400000U!	2.5E+10	Census Tr	720	33	34	653	
21	1400000U!	2.5E+10	Census Tr	2914	498	168	2248	
22	1400000U!	2.5E+10	Census Tr	5407	289	60	5058	

This file contains the **data** and the **headings**. Notice how there are essentially two headings. The first row contains “Data Speak” and the one below contains written out explanations.

3. Now look at the “DEC_10..._metadata” file. This file explains the column header codes in the data file - it should look something like what you see below. This is a very important file!!!

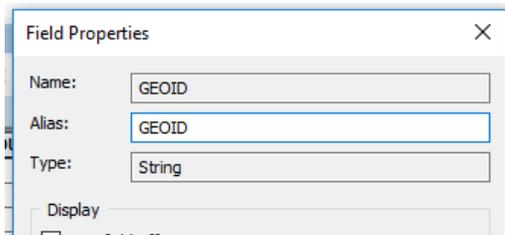
	A	B	C	D	E
1	GEO.id	Id			
2	GEO.id2	Id2			
3	GEO.displ	Geography			
4	D001	Total population in occupied housing units:			
5	D002	Owned with a mortgage or a loan			
6	D003	Owned free and clear			
7	D004	Renter occupied			

Typically the first data column (D001 here) is the **Universe** of things counted in this table. This table is counting people in occupied housing units. If you wanted to show the % of the population that is in rented housing units, you would divide D004 by D001 and multiply by 100. This process is called “normalizing.”

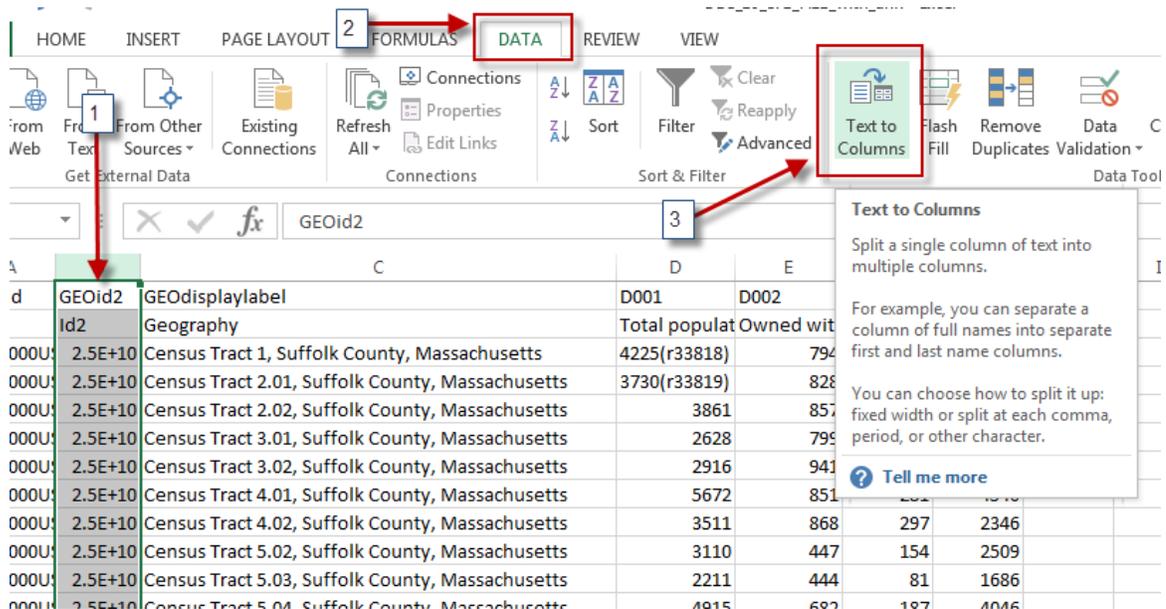
A few important steps left.

Go back to the excel file containing the data. Now we need to clean it EXTENSIVELY so that we can join it in ArcMap. ArcMap is VERY picky about how data is formatted!!! Make sure to follow all rules below:

1. The very top row (with all the data speak headings) will be our Attribute table headings. ArcGIS does not like ANY extra characters in the column names. Delete all periods (.) and extra characters (-) in all the **column names/heading**. The only acceptable character is underscores (_).
2. In ArcMap, open the census tracts attribute table. Find the GeoID field heading. Right click on it and open the properties. You will notice that it says it's a string. String means that it is formatted as text (not a number). It needs to be formatted as text so GeoIDs that start or end with a 0 don't get adjusted to drop the 0 (for example, zip codes like 02144 don't get automatically changed to 2144).

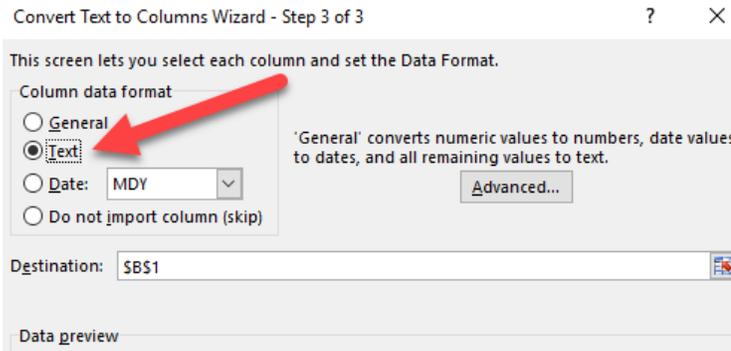


3. Since our joins need to have fields that match **EXACTLY**, both the excel data field and the attribute table field that will be matched (joined) need to both be strings/text.
4. Back in excel, notice the **GEOid2** field. **This is the field that exactly matches what is in the census tracts attribute table. However, we can't really tell right now because it's formatted as a number and therefore changes the number to read as 2.5E+10.** As a result, this field must be changed to *text* for the join to work properly. Follow the image below...
 - a) Highlight the GEOid2 column.
 - b) On the Excel toolbar at the top, click on the **Data** tab
 - c) Click on *Text to Columns*:



- d) Click **Next** to leave the first setting at Delimited.

- e) Click **Next** to leave the second setting at Tab.
- f) In Step 3, change the column data format to **TEXT**, and then hit **Finish**. This will format ONLY THIS ONE COLUMN as text (because we still want all the data itself to be a “number”).

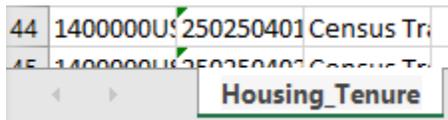


- 3. Notice now how all the numbers in GeoID2 now look identical to how the GEOID field is formatted in ArcMap. We’re getting closer.
- 4. Census.gov now includes the description of the column under the column heading in the excel sheet (e.g. Under D001 it says Total Population). However, ArcMap does not like this extra row and the text causes the software to read it as a “string” (e.g. text) instead of “double” (e.g. numbers). Therefore, it is necessary to delete this row so that ArcMap realizes that this is a number field and not a text field.

	C	D	E	F	G	H	I
		D001	D002	D003	D004		
2	Id	Id2	Geography	Total populat	Owned with	Owned fr	Renter occupied
	0		Census Tract 1, Suffolk County, Massachusetts	4225	794	231	3200
	0		Census Tract 2.01, Suffolk County, Massachusetts	3730	828	262	2640
	0		Census Tract 2.02, Suffolk County, Massachusetts	3861	857	349	2655
	0		Census Tract 3.01, Suffolk County, Massachusetts	2628	799	270	1559
	0		Census Tract 3.02, Suffolk County, Massachusetts	2916	941	413	1562
	0		Census Tract 4.01, Suffolk County, Massachusetts	5672	851	281	4540
	0		Census Tract 4.02, Suffolk County, Massachusetts	3511	868	297	2346
	0		Census Tract 5.02, Suffolk County, Massachusetts	3110	447	154	2509
	0		Census Tract 5.03, Suffolk County, Massachusetts	2211	444	81	1686
	0		Census Tract 5.04, Suffolk County, Massachusetts	4915	682	187	4046

Optional Tip – Although you need to delete the 2nd row of text, you can change the column headings to the descriptions if it makes it easier (e.g. Change D001 to Tot_Pop). However, there can be no spaces or periods and the heading needs to be under 9 characters. For excel sheets containing several fields, it’s probably easier to refer to the codes later rather than changing all the column headings.

- 5. To make things easier later, rename the worksheet to something comprehensible, e.g., *Housing_Tenure* - the worksheet name will be the identifier in ArcCatalog.



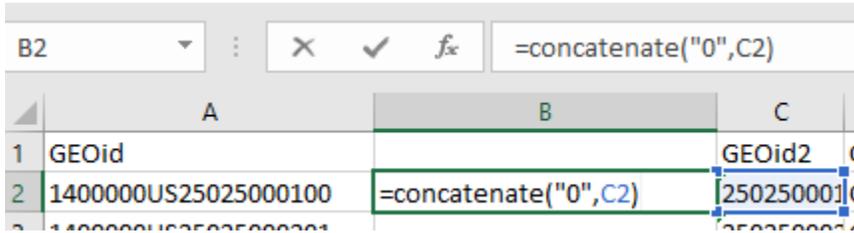
- 6. Very important step – **save your modified CSV file as an Excel Workbook (.xlsx)** – give it a comprehensible name, e.g., *2010CensusH11_populationbyhousingtenure.xlsx*. Save it in your H Drive Aff_Data Folder

Note: Your table may have columns where the data has text values in it. For example, column D001 (which is total population) has data like 4225(r33818) or 3730(r33819). Since ArcMap uses the first eight rows to determine what the data type is for each column (ex: string, float, double, integer, etc.), it is necessary to delete the information in parentheses for it to be mappable as a number.

	A	B	C	D	E	F	G
1	GEOID	GEOID2	Geo_display	Tot_Pop	Own_Loan	Own_Free	Renter
2	1400000US25025000100	25025000100	Census Tract 1, Suffolk County, Massachusetts	4225(r33818)	794	231	3200
3	1400000US25025000201	25025000201	Census Tract 2.01, Suffolk County, Massachusetts	3730(r33819)	828	262	2640
4	1400000US25025000202	25025000202	Census Tract 2.02, Suffolk County, Massachusetts	3861	857	349	2655
5	1400000US25025000301	25025000301	Census Tract 3.01, Suffolk County, Massachusetts	2628	799	270	1559
6	1400000US25025000302	25025000302	Census Tract 3.02, Suffolk County, Massachusetts	2916	941	413	1562

7. **Extra step for Alaska, Alabama, Arkansas, Arizona, California, Colorado, and Connecticut.** (*Ignore this section if you are not working in these states*)

Some states have FIPS codes that start with a zero, and because Excel removes that leading zero, the table won't join properly unless we put it back on. If you're working in Alaska, Alabama, Arkansas, Arizona, California, Colorado, or Connecticut, you'll have to add that zero back on manually. To add the zero back on, create a new column next to GEOid2, in Row2 type in: `=concatenate("0",C2)`.



Hit **Enter**. If the result of that formula looks right (i.e. it has a leading zero), copy that cell's formula to the rest of the column.

You're almost done! To keep this compatible with the rest of the directions, copy all of the cells in this new column, and right click on the GEOid2 column. Click the options below **"Paste Special"**, choose **Values**, and your leading zeroes should be all set. Ensure your column is still named GeoID2.

Delete the column you added but be sure you still have the fixed GeoID2 column. Save the file!

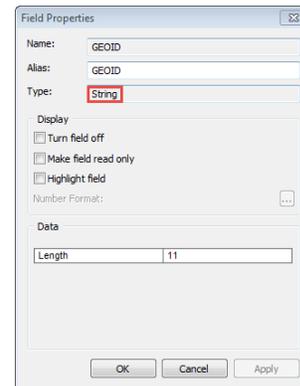
Final STEP: Save your file and EXIT out of Excel – you CANNOT have Excel open still when you work with this data in ArcGIS!

Now you're ready for mapping!

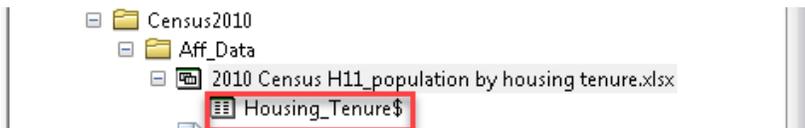
Joining the AFF table to your Census Tract polygons in ArcMap

1. In ArcMap, open the Census Tracts polygon attribute table and take a look at it.
2. Which column matches the excel document EXACTLY? The GeoID in the attribute table matches the GeoID2 from the excel table exactly! **Therefore, we will use the *GeoID* column to join our AFF data.** Remember from class, that GeoID is a concatenation of the State FIPS Code (25 for Mass) plus the County FIPS Code plus the Tract FIPS code. Every single tract in the US has a unique ID! This unique ID is the best way to identify counties, especially since many different states contain counties with the same names.
3. Right-click on **GEOID** field name and choose **Properties**. You'll see it is a **string** type attribute field – that's important to know. Strings are the same as "text", which is why we changed GeoID2 to "text" in excel! Close the table.

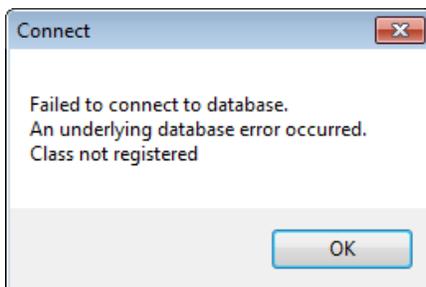
FID	Shape	STATEFP10	COUNTYFP10	TRACTCE10	GEOID
0	Polygon	25	025	010405	250250
1	Polygon	25	025	010404	250250
2	Polygon	25	025	010801	250250
3	Polygon	25	025	010702	250250
4	Polygon	25	025	010204	250250
5	Polygon	25	025	010802	250250
6	Polygon	25	025	010104	250250
7	Polygon	25	025	000703	250250
8	Polygon	25	025	000504	250250
9	Polygon	25	025	000704	250250
10	Polygon	25	025	010103	250250
11	Polygon	25	025	000803	250250
12	Polygon	25	025	980300	250250
13	Polygon	25	025	120201	250251
14	Polygon	25	025	120104	250251



4. In Catalog, add your census excel sheet to the map. If you don't see it in Catalog, refresh the folder by right-clicking it and selecting "Refresh". You will need to drill down to the sheet level, as shown below. If there is still a plus sign, you haven't gone deep enough! Drag the "Housing_Tenure\$" sheet into your map like you would a shapefile.



5. If you get the following error, it means that your version of ArcGIS and Excel are having connectivity issues. A solution may be to save your Housing Tenure excel sheet as an Excel 97-2003 Workbook (*.xls) or CSV.



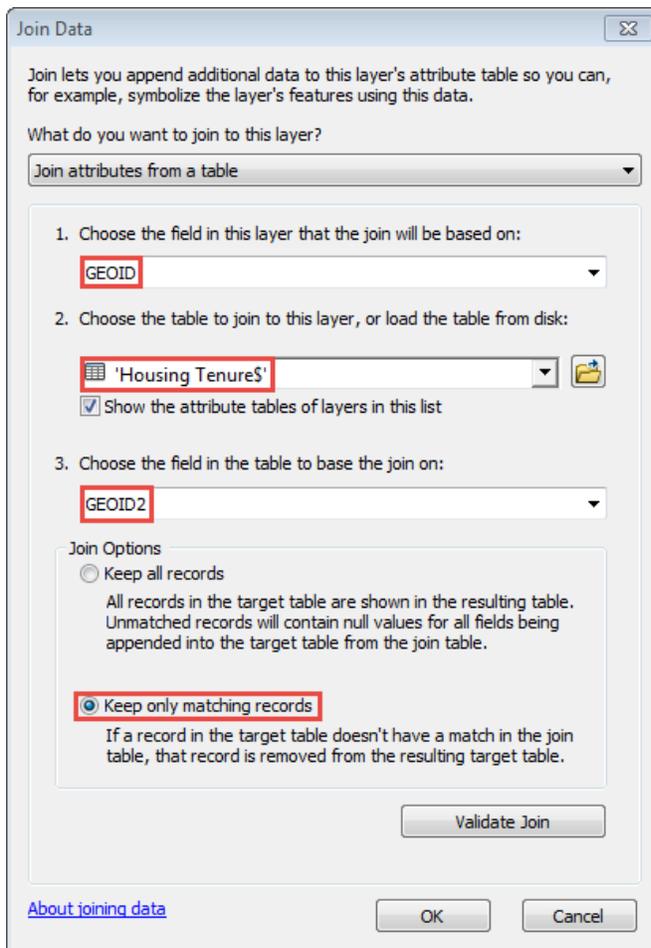
6. In the Table of Contents, open *Housing_Tenure Table* by right-clicking on it and choosing *Open*- very similar to how you would open an attribute table.

	GeoID	GeoID2	Geography
	1400000US25025000201	25025000201	Census Tract 2.01, Suffolk County, Massachus
	1400000US25025000202	25025000202	Census Tract 2.02, Suffolk County, Massachus
	1400000US25025000301	25025000301	Census Tract 3.01, Suffolk County, Massachus
	1400000US25025000302	25025000302	Census Tract 3.02, Suffolk County, Massachus
	1400000US25025000401	25025000401	Census Tract 4.01, Suffolk County, Massachus
	1400000US25025000402	25025000402	Census Tract 4.02, Suffolk County, Massachus
	1400000US25025000502	25025000502	Census Tract 5.02, Suffolk County, Massachus

GEOID2 will be used to join this AFF data to the 2017 Census Geography. These two fields match exactly. It's OK that they have different names. Check its properties to ensure that it is also a STRING type, close the table when done.

Take a second to realize that you will not be joining the GeoID to GeoID. You will instead be joining GeoID2 (from the Housing_Tenure\$ table) to GeoID in the Census Tracts shapefile.

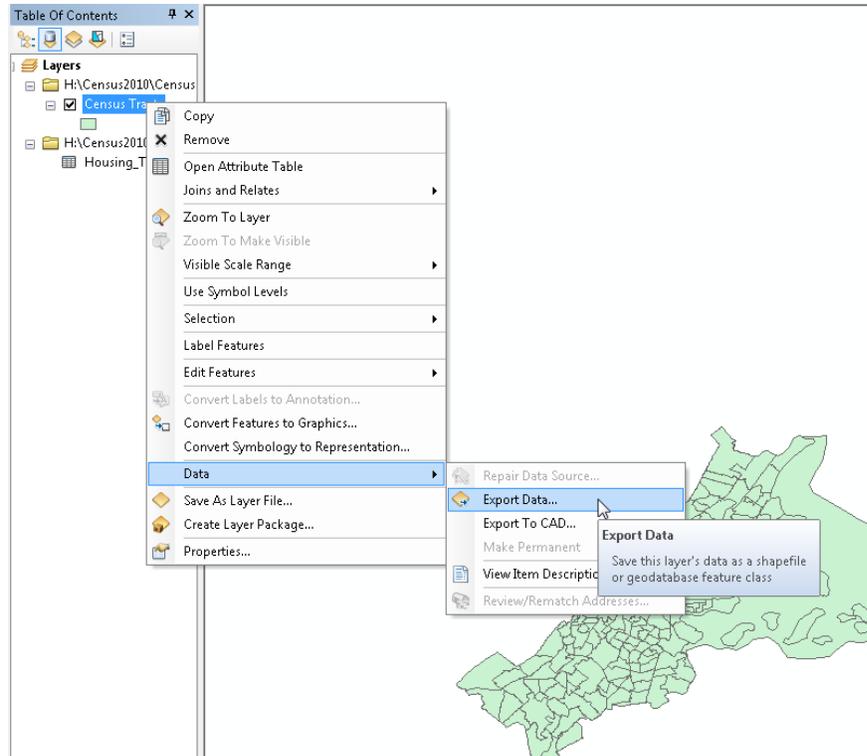
7. Right click on the GeoID2 field → Properties, and double check that the type is indeed a **String**. If it says double, you did not convert it to text in excel and must go back and redo that step (Page 8, step 4). That's why I had you check twice. If it says string, you are good to proceed! Close the attribute table.
8. Right click on your **Census Tracts** and choose **Join & Relates**, then select **Join...**
9. Fill in the dialog box as follows. You are joining attributes from a table (the spreadsheet, in this case Housing_Tenure\$) using **GEOID** in your **Census Tracts** layer and **GEOID2** in your **Excel** table. Click OK when done:



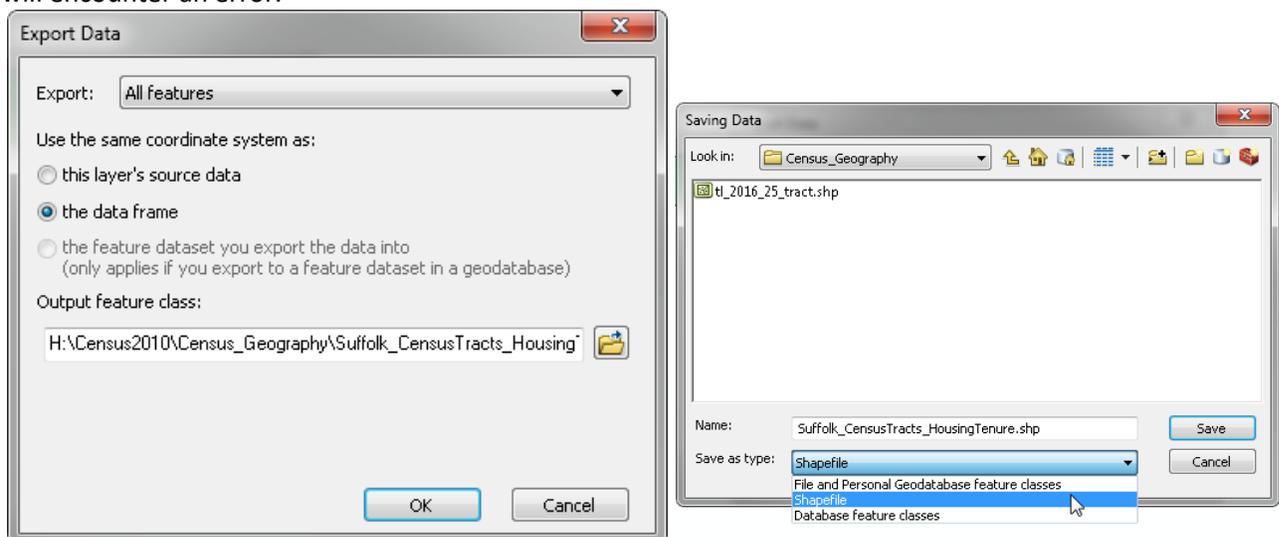
Note: By clicking “Keep only matching records”, only Suffolk County will remain visible in the shapefile because we only downloaded census tabular data for this one county in MA. If we select “Keep all records”, MA would remain whole, however, the attribute table would only have housing information for the census tracts within Suffolk County. The rest of the census tracts would read “Null” in those joined fields.

10. Open *Census Tracts* attribute table to ensure that the join was made correctly. If so, you should see your housing tenure AFF data when you scroll to the right in the table. Close the table.
11. **It is important to know that when you make a join it is not permanent until you EXPORT THE DATA.** Until you export, the join is only temporary. If you run any tools on this layer without exporting the data, it will drop the joined data. Exporting the data saves this shapefile as a NEW shapefile, where the join is now permanently part of the attribute table.

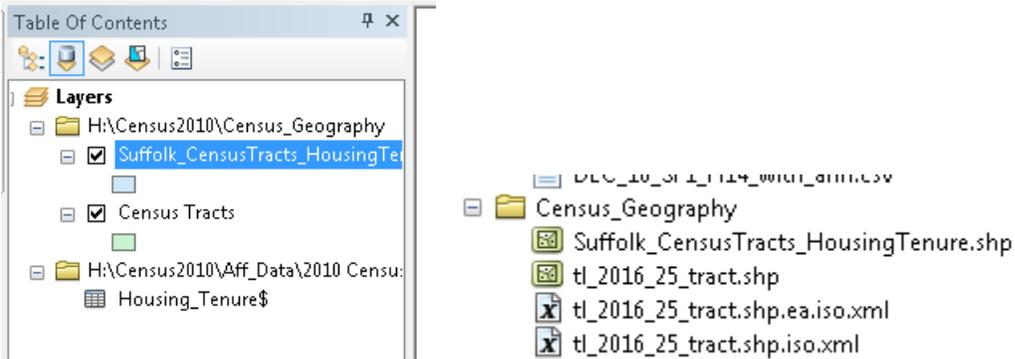
Export the data by right clicking on the census tracts, selecting **Data** and then **Export Data**.



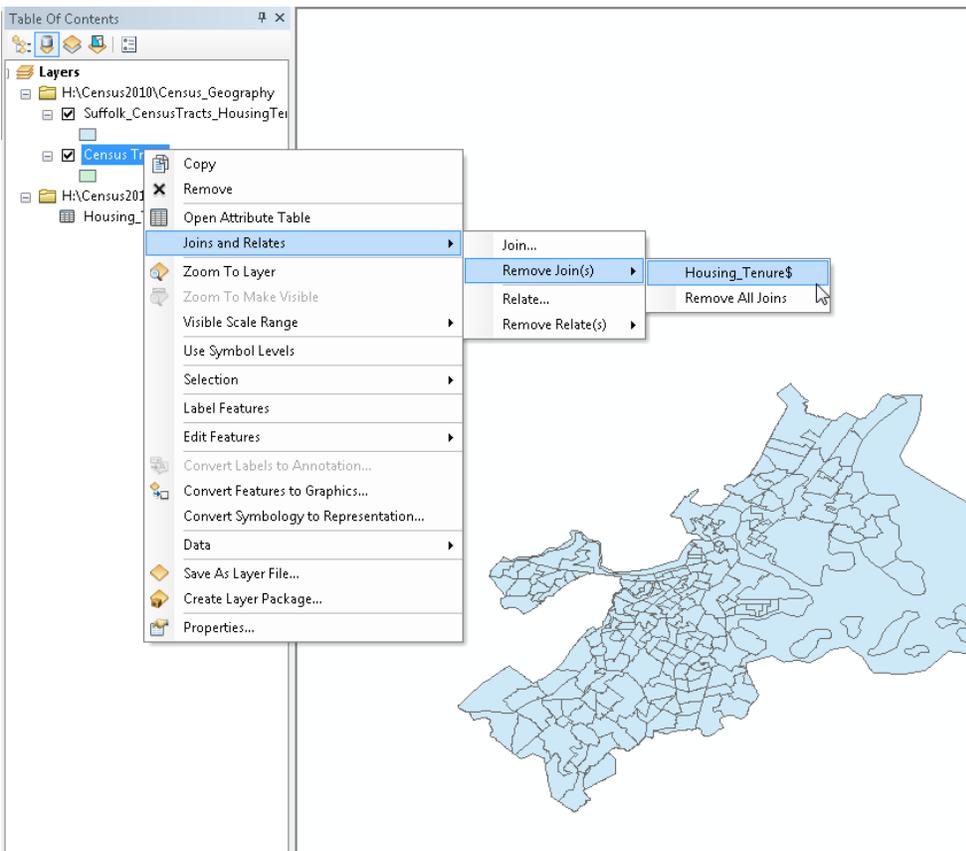
12. Save the shapefile with an appropriate name inside the Geography folder (include Census tracts so you know the boundaries and include the location). It can be good to acknowledge exactly what has been joined, especially if you end up having multiple joined layers. Also, make sure to save as a shapefile, otherwise you will encounter an error.



13. Exporting data is always good practice to ensure something is **permanent**. It also sometimes resolves minor ArcGIS glitches, such as layers not drawing on the map.
14. Now before hitting OK you will need to decide if you want to save this new shapefile to the coordinate system it came with (2016 Census Data uses GCS_North_American_1983), or if you have already put the data frame into a certain projection you could select data frame (this map ultimately uses NAD_1983_StatePlane_Massachusetts_Mainland_FIPS_2001). By setting your data frame projection first, this then saves you the step of projecting your data later!
15. Press ok and click yes when asked if you want to add the exported the data to the map as a layer. Now, you should see a new layer in the Table of Contents with your given name. It has also been added to the Catalog!



16. Since you have saved this join as new shapefile, you can remove the join from the original Census Tracts Shapefile. Right click on Census Tracts, and click **Joins and Relates** and then **Remove Join(s) → Housing_Tenure\$**.



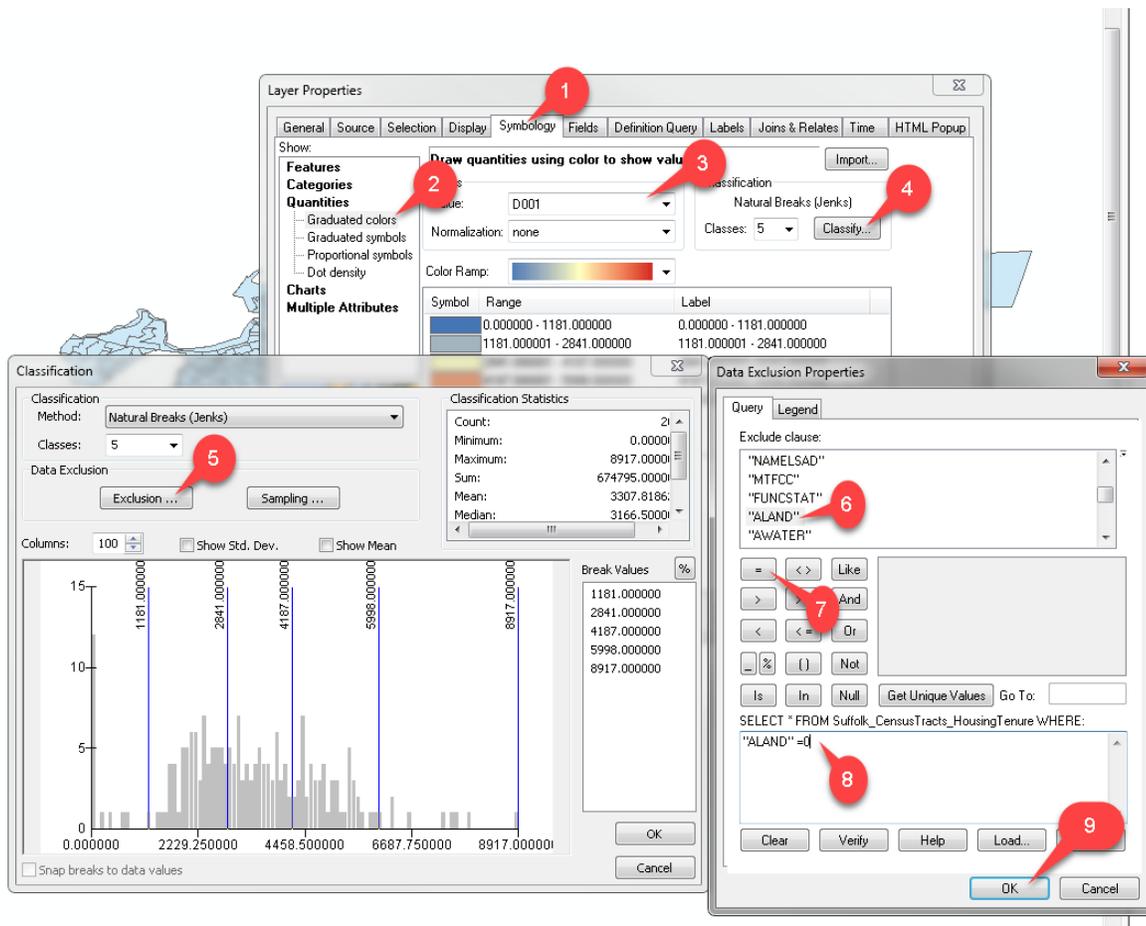
17. When you do this it removes the excel data in the Census Tracts attribute table, and the shapefile reverts back to all of Massachusetts. The reason why you would want to remove the join is so you can join a new or different tabular dataset to this shapefile without having to download it again from the census.
18. After you remove the join from the original Census Tracts layer, turn the layer off. You are done working with this one.

Removing Water Only Census Tracts

If your area of interest is near water or has water features in it (like Boston), your census tract data will extend into the water. Why? Because people live on islands and on boats, and census tracts includes those areas! However, we don't always want to map them, so let's remove them.



1. To get rid of the water tracts from your new shapefile, right-click it and open the layer Properties, and click on the **Symbology** tab.
2. Click on *Quantities*.
3. Under *Value*, choose the variable **D001** (or Tot_Pop if you renamed it in excel first).
4. Then click on *Classify*.
5. In the *Classify* dialog box, click on **Exclusion**. You can exclude all census tracts where the **land area is equal to 0** (no land, only water), and hit OK. This process is shown in steps 6-9 depicted below:



6. Now you can map your data without having to include water-based census tracts. If you are unfamiliar with mapping numeric values using symbology, see the [ArcGIS 10.2 online help – About Symbolizing Layers to Represent Quantity](#).

Note: Do not just accept the default colors. Play around with the different color schemes!

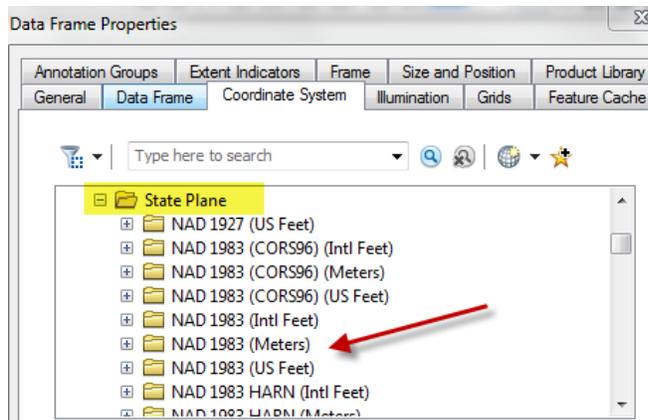
7. Your data is ready to map. Make sure to save often!

Setting a Projected Coordinate System for your Map

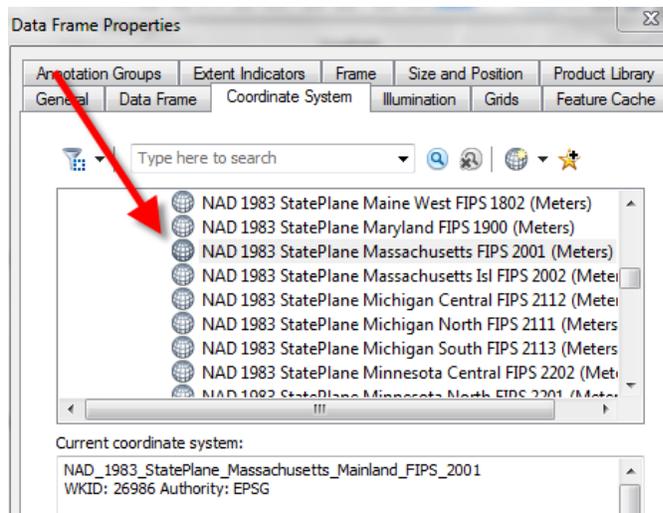
It is always necessary to put your map into an appropriate projected coordinate system. The TIGER data is in a geographic coordinate system (GCS) and can appear distorted on your map. You can fix this problem by setting a projected coordinate system appropriate for your region.

You will need to know the best coordinate system to use for your area of interest. In the case of Massachusetts, we will use the Massachusetts State Plane (NAD83) – meters coordinate system. If you don't know which coordinate system to use, use [this resource](#). It is a quick read that gives you an understanding of what factors to consider when selecting a projection, and provides a helpful table at the end.

1. Click on **View → Data Frame Properties**.
2. Click on the **Coordinate System** tab.
3. Scroll down till you find the **Projected Coordinate Systems** folder. Make sure you are not still in the “Geographic Coordinate System” folder.
4. Scroll down to the **State Plane** folder – open that folder and select **NAD 1983 (Meters)** from the list:



5. Find **NAD 1983 StatePlane Massachusetts Mainland** (not Isl which means Islands) and click on it:



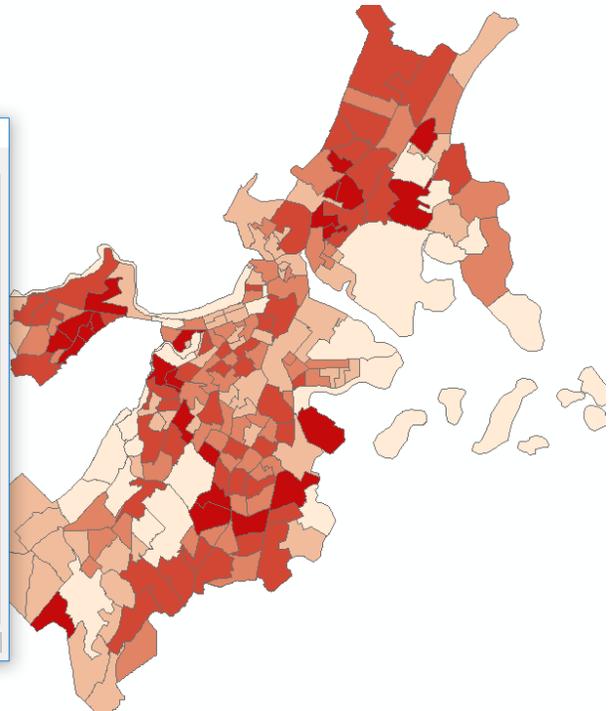
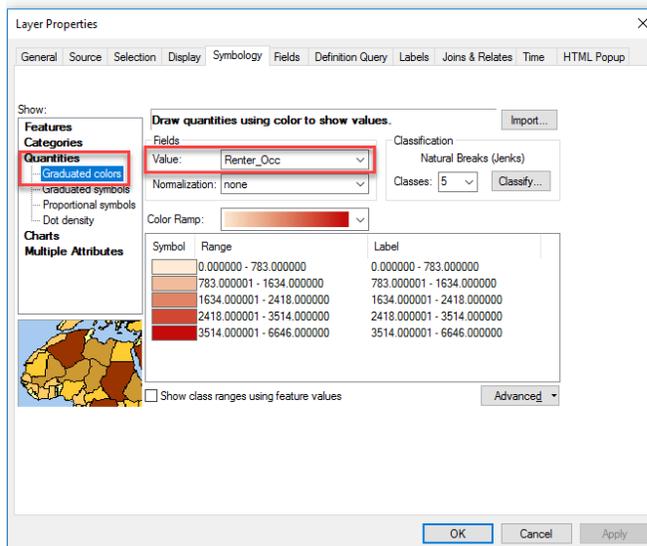
6. Click **OK** and click **Yes** when warned that the coordinate system is different from the data in your maps.

You're done! You have successfully downloaded American Fact Finder data (AFF) and joined it to Census Geography data in ArcMap. The process of finding and preparing data can be time consuming, but doing it correctly is important to ensure that your maps and the information they are conveying is accurate.

Using Symbolology to Map a Demographic Variable

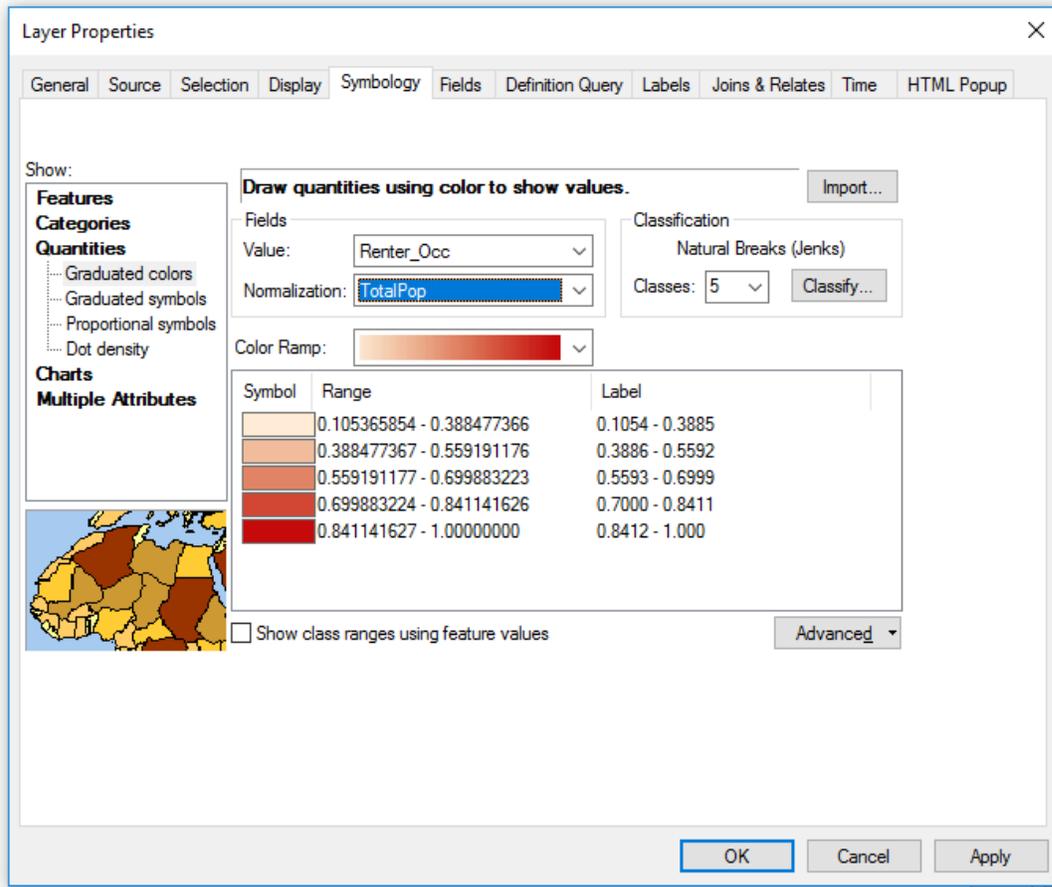
Now that our join is successful, we want to use symbology to show one of our demographic variables by census tract. Let's open up the attribute table of the **Suffolk_CensusTracts_HousingTenure** layer to remember what our options are for the demographic variables on tenure.

- Let's map the D004 variable (Renter Occupied). If we were to symbolize this variable, it would just be a *raw count* of the population living in renter-occupied housing units. Instead, we want to show a percent so that we can better compare between census tracts and better understand what the data means. This is called *normalizing*. It is very important when analyzing any dataset.
- In order to make this number a percent, we must divide the **population of renter-occupied housing units (D004)** by the **Total population in occupied housing units (D001)**.
- Double click on your new shapefile **Suffolk_CensusTracts_HousingTenure** to get to the properties. Then click on the **Symbology** tab.
- Since we want to map numbers select **Quantities** on the left hand side of the symbology box.
- The **Value** field dropdown contains all the **Attribute Table** headings. Let's select **D004** or the variable that represents population of renter-occupied housing units (below it has been relabeled to **Renter_Occ**). Hit Apply – the map updates, even though the property box remains open. You can move the Property box out of the way to see the map! See below for an example of how to change the symbology.



Note: As it stands, the map is NOT illustrating a percentage of the population living in renter-occupied housing units. This is just the **raw count of the population living in renter occupied households**. It is not useful for comparisons, since census tracts are varying sizes.

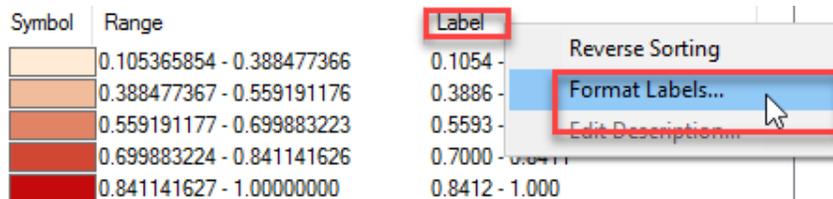
- In order to compare values between census tracts, we must turn this number into a percent. This means taking the total population living in renter occupied households and **dividing it by the TOTAL POPULATION in occupied housing units**. This process is called **Normalizing** and it is an important statistical operation that allows comparison of two different sized areas.
- To do this, we select the **Normalization** field in symbology. We know that **D001** is the field containing data for the total population in occupied housing units. If you changed field labels, you may have a field titled **TotalPop** or something similar instead. Change the normalization field to **D001** or **TotalPop**.



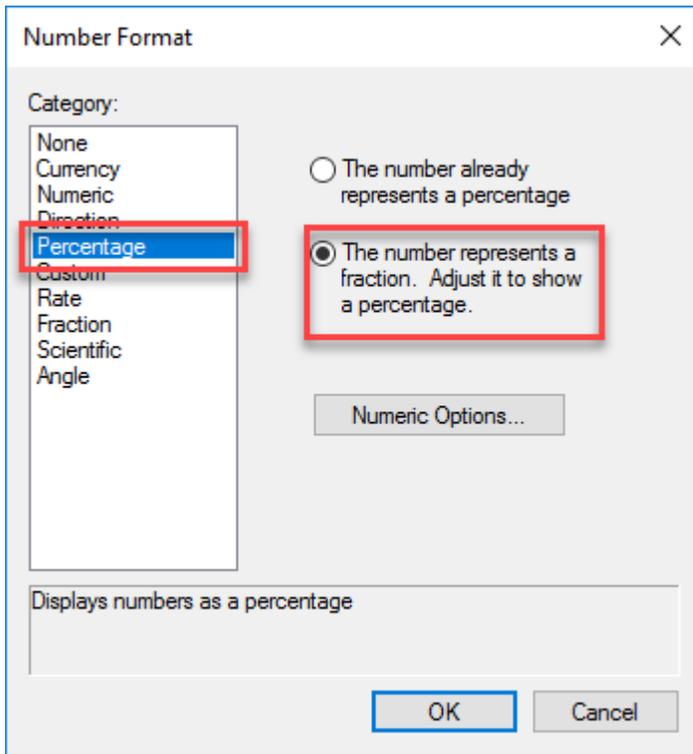
8. Click **Apply**. Notice how the map changes. Also, the numbers changed under the Label column. Now they are fractions representing population of renter-occupied housing units divided by total population of occupied housing units. To format the labels to show percentage, we must multiply them by 100.

Symbol	Range	Label
	0.105365854 - 0.388477366	0.1054 - 0.3885
	0.388477367 - 0.559191176	0.3886 - 0.5592
	0.559191177 - 0.699883223	0.5593 - 0.6999
	0.699883224 - 0.841141626	0.7000 - 0.8411
	0.841141627 - 1.000000000	0.8412 - 1.000

9. ArcMap makes it easy to format numbers. Click on **Label** → **Format Labels...**



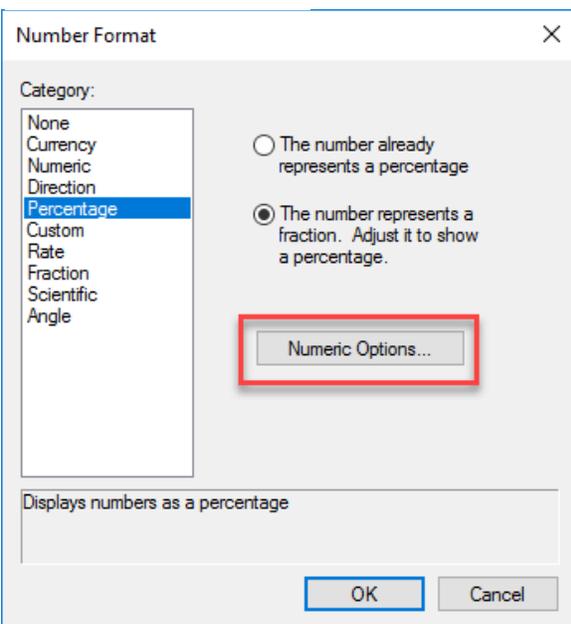
- There are already a bunch of different number categories. Since we want to convert the fractions to percentage, click on **Percentage** on the left. Now, two options appear. Since the numbers currently represent a fraction, and we want to adjust it to show a percentage, select the 2nd option. Now, ArcMap will automatically multiply our numbers by 100 without us having to do anything!



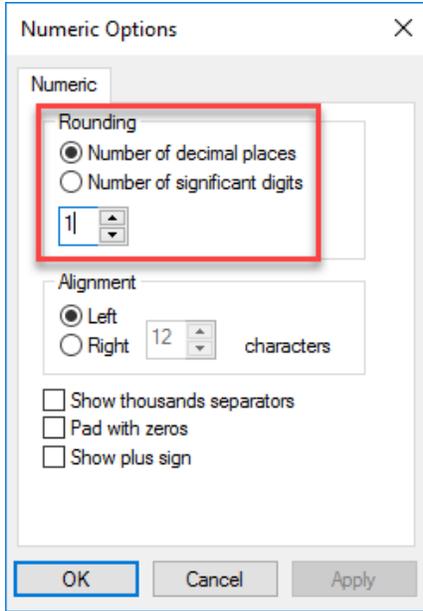
- If you hit OK now, our numbers will be in percentage, but they will have a lot of decimal places that make it hard to read. If you have hit OK, go back to the Number Format properties (click on Label > Format Labels > Percentage). In the **Number Format** box under Percentage, click **Numeric Option**.

Label

10.536585% - 38.847737%
 38.847738% - 55.919118%
 55.919119% - 69.988322%
 69.988323% - 84.114163%
 84.114164% - 100%



- This opens up another box, which allows us to choose the number of decimal places or significant digits. Let's limit our labels to 1 decimal place.



- Now press OK, then OK, then **Apply**. Now our numbers are MUCH more simplified and easier to read.
- Pick a gradual color scheme (light to dark) that you like in the **Color Ramp**. Press apply to see how the different colors look. Find one you like, and close the Layer Properties window by clicking OK.
- Lastly, let's change the layer name and heading in the table of contents so that when we add our legend it looks good! Change the name of Suffolk_CensusTracts_HousingTenure to **Census Tracts**. Then change the **heading name** to **% Renter-Occupied Households**.

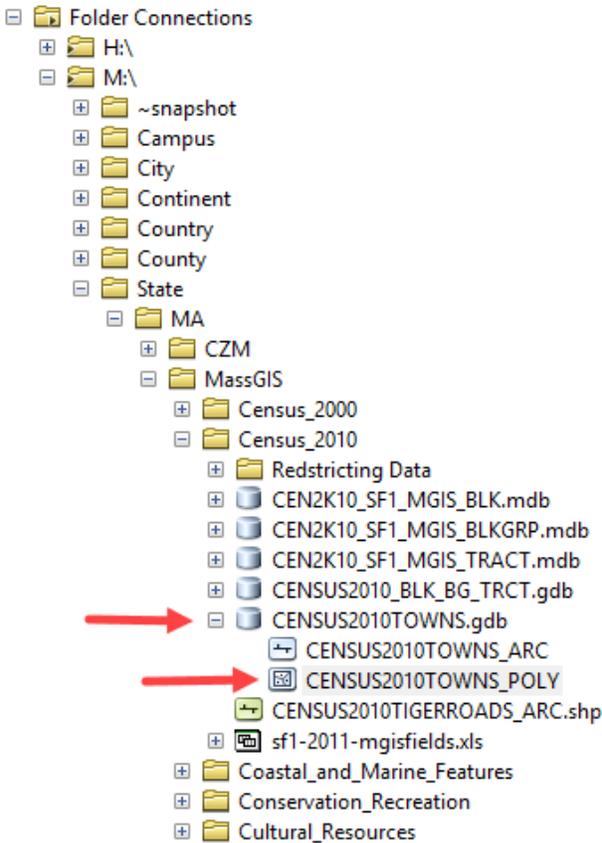
- Census Tracts**
 % Renter-Occupied Households
 - 10.5% - 38.8%
 - 38.9% - 55.9%
 - 56% - 70%
 - 70.1% - 84.1%
 - 84.2% - 100%

- Save your map.

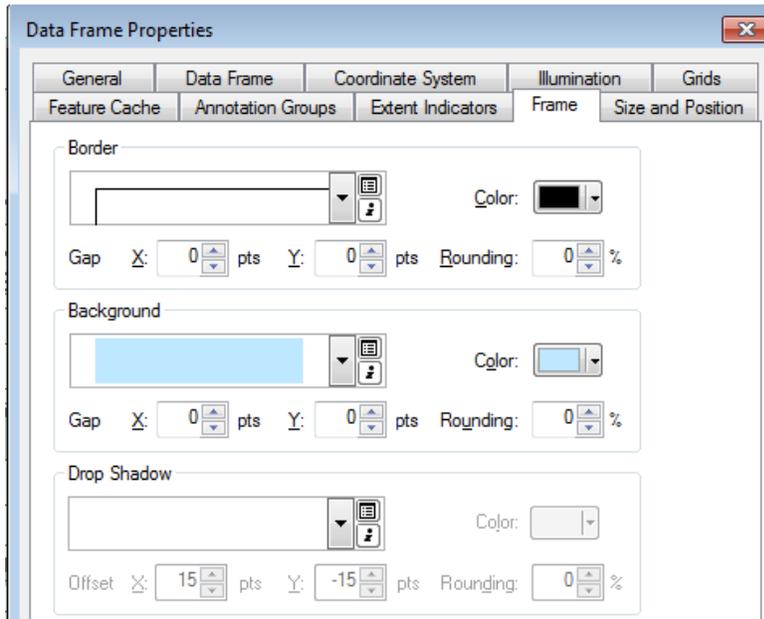
Adding Base Map Data

Our map is coming along nicely, but for the final product, we should add some other data so it does not appear that Boston is floating in the middle of nowhere! We are going to pull in the Census Towns polygons from the M drive.

1. In Catalog, open the M drive.
2. Navigate to State → MA → MassGIS → Census_2010 → CENSUS2010TOWNS.gdb → CENSUS2010TOWNS_POLY



3. Pull in **CENSUS2010TOWNS_POLY**. This is the Census Towns polygons layer.
4. Change the name of **CENSUS2010TOWNS_POLY** to **Towns** and drag it underneath your census tracts and change the color to make it a neutral background color – either a very light yellow or light gray. That way, it does not draw a lot of attention.
5. Now, the only thing missing is to turn the water blue! We could find a water layer and pull it in, or we can use a very helpful shortcut! Double click on the Data Frame (aka Layers) or go to View → Data Frame Properties.
6. Click on the **Frame** tab and change the **Background** color to a blue. Press OK. Disregard the error about coordinate systems (at least for this week).

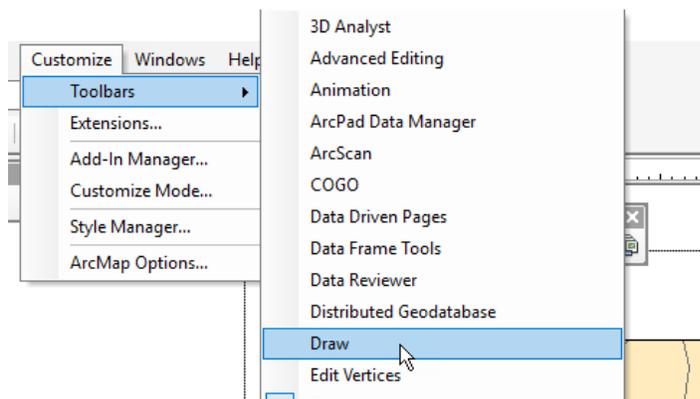


Disclaimer: If the map projection changes when you change your background color to blue (you will know because the map will seem to spread out horizontally), go back and set the projection under the **Coordinate System** tab. See “Setting a Projected Coordinate System for your Map” section on page 18. Note, this should not happen and likely will not.

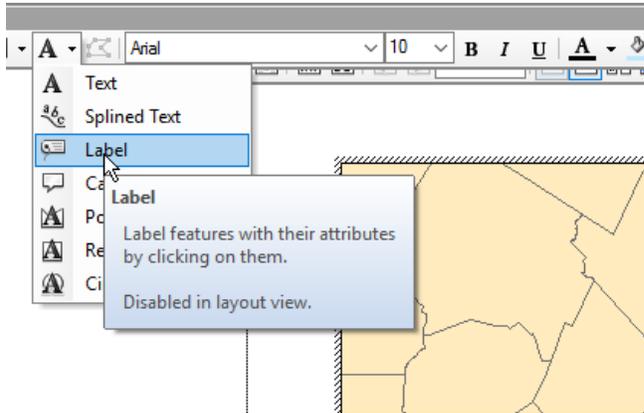
7. Voila! Now our water is blue.

Creating a Map Layout

1. Switch to Layout View so we’re setting up our piece of paper.
2. You’ll likely want to switch your paper to landscape, which is done in the File → page and print setup.
3. Set up the Data Frame on the piece of paper how you would like it arranged. Then, zoom into Suffolk County so it fills out the whole data frame area really well.
4. Time to add some labels. Go to **Customize → Toolbars** and select the **Draw** toolbar. This toolbar is VERY handy!

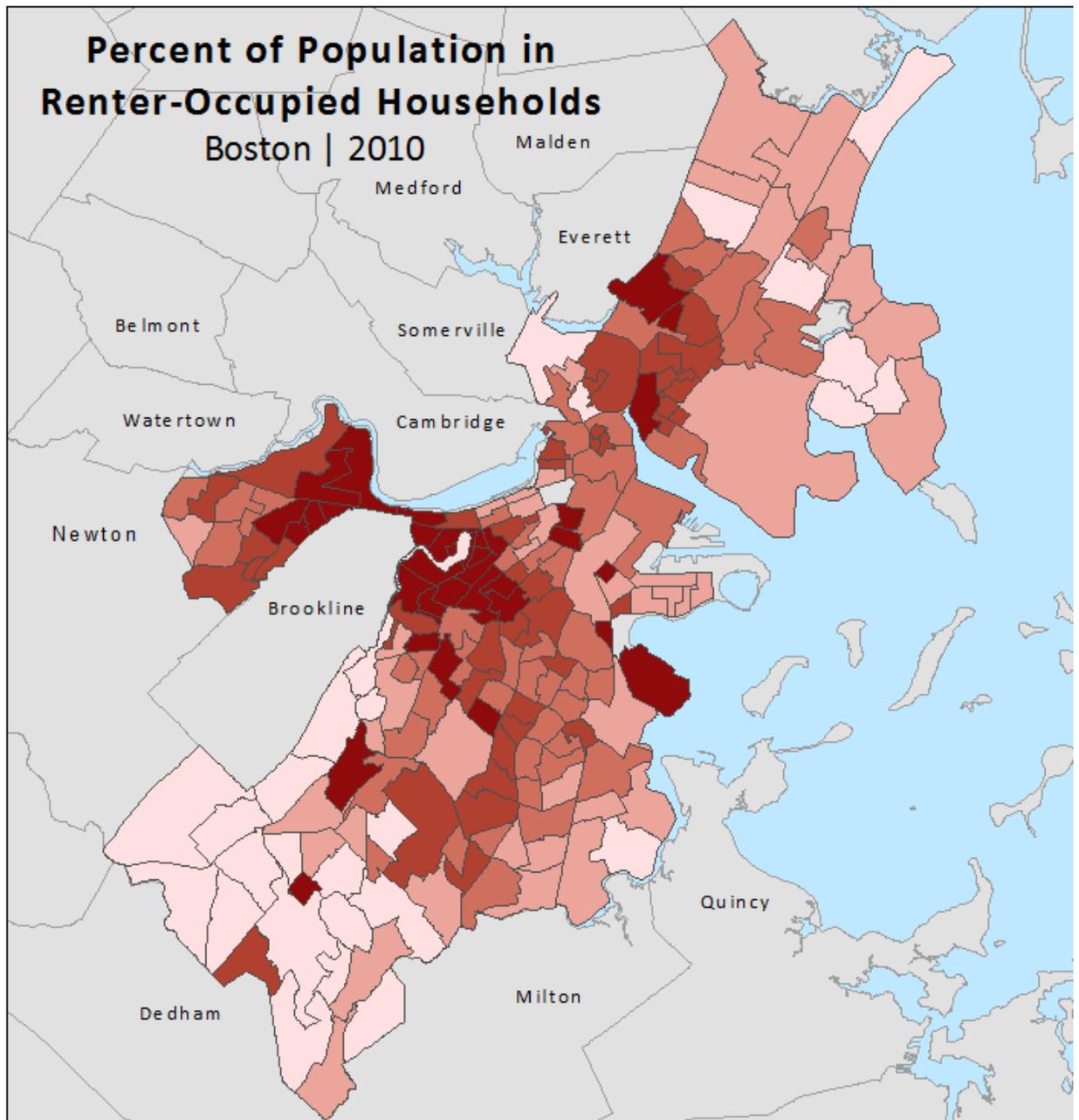


- Next to the **A**, click the little down arrow and select **Label**. This allows you to label individual features and pulls the info from the attribute table. We will label the surrounding towns. If label is greyed out, double click on the data frame using the pointer arrow to get the slashes and activate it.

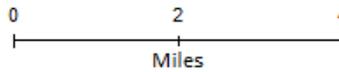


- In the Label Tool Options window that appears, click **Place label at position clicked**. Now click inside Brookline. You will see it adds a label wherever you clicked. You can move these labels easily by clicking on them and moving them.
- Add a label for other surrounding cities.
- One thing you might notice is that they are so tiny. Click the **select arrow** on the toolbar. Then hold down the **Ctrl** button and click each label. This will select them all at once.
- On the draw toolbar, you can now use the font drop down and size drop down to make them **bigger** and **bold**. One thing that looks really nice is to give the state labels a bit of **character spacing**. When they are all highlighted, choose your **font** and **size**. Then, right click on one of the labels → properties. Change the **Character Spacing** to 30.
- Let's also change the color of the font to a **grey**, so the black isn't so aggressive and the first thing you notice. These labels should fall into the background.
- Now, move forward with putting in the rest of the map elements as you learned in the ArcGIS Basics tutorial (title, legend, scale, bar and data citation text/date).

Check out the example map below:



Barbara Parmenter
UEP 232 | Intro to GIS
January 25, 2018



Data Sources: MassGIS, US Census, American Fact Finder (Table H11)
Projection: NAD 1983 Massachusetts State Plane

