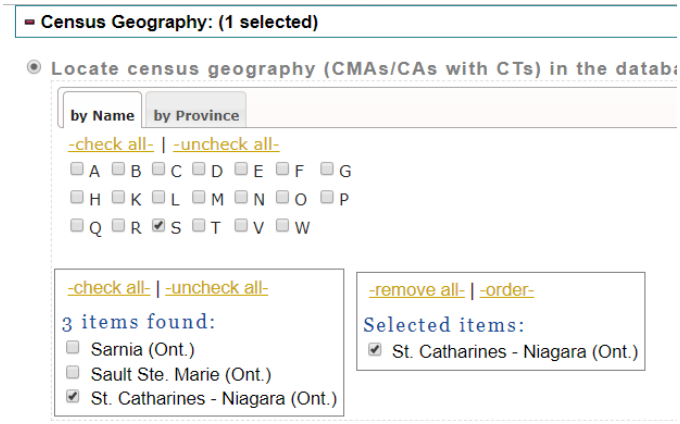
Quantitative Mapping Using Census Data

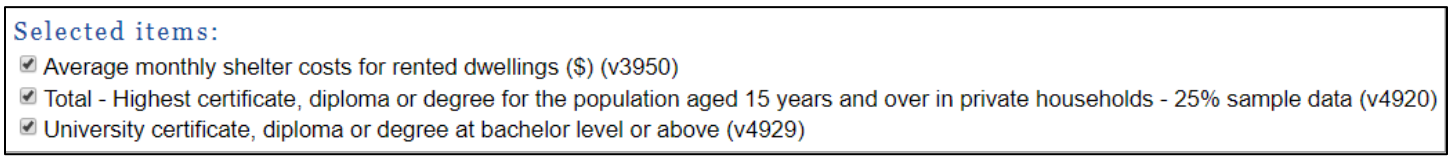
This tutorial includes all necessary steps to create a thematic map using numeric census tract data – from data acquisition; excel file formatting; preparing a boundary shape file; to the final product of designing a choropleth map.

STEP ONE: Download census data from CHASS

1. Navigate to the University of Toronto CHASS Site http://datacentre.chass.utoronto.ca/census/ "Canadian Census Analyzer"
2. Under Census Profile Tables > by Census Geography (select **Census Tract**)
3. Select 2016.
4. **Step 1: Specify Census Geography for retrieval**
    a. Under the heading Locate census geography, click the checkbox beside the letter 's'.
    b. Check the box beside St. Catharines – Niagara (Ont.)



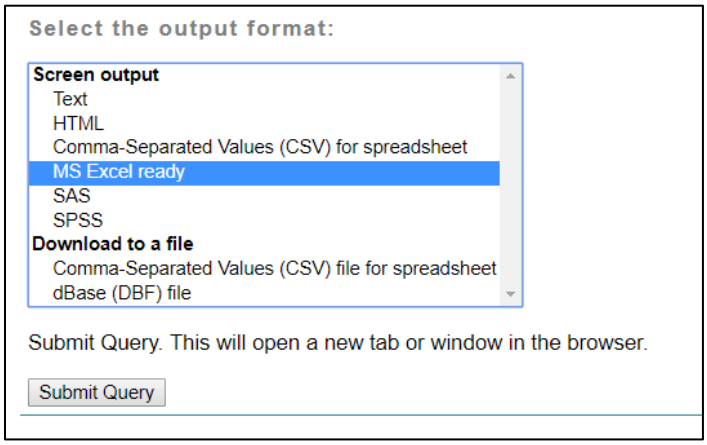
5. **Step 2: Specify Census Profile variables for retrieval**
    a. **Housing** Profile, select the following:
        i. Average monthly shelter costs for rented dwellings ($)(v3950) (HINT: scroll to the bottom)
    b. **Education** Profile, select the following:
        i. Total – Highest certificate, diploma or degree for the population aged 15 years and over in private household – 25% sample data (v4920)
        ii. University certificate, diploma or degree at bachelor level or above (v4929)



6. Scroll down to **Step 3: specify the output details and submit query**
7. Scroll down to **Select the output format**:

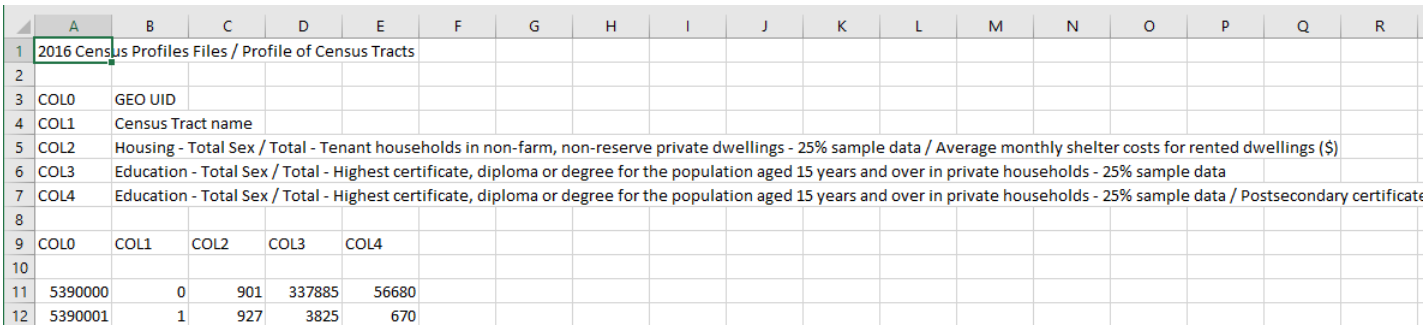
a. Select MS Excel ready

8. Click **Submit query**.



The CSV file is automatically downloaded to your **My Downloads**.

9. Run File Explorer and create a new folder for this project called "CENSUS". Copy/paste the CSV into the new folder.
10. Open the file (default name is "**census.csv"**) in MS Excel.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	2016 Census Profiles Files / Profile of Census Tracts																	
2																		
3	COL0	GEO UID																
4	COL1	Census Tract name																
5	COL2	Housing - Total Sex / Total - Tenant households in non-farm, non-reserve private dwellings - 25% sample data / Average monthly shelter costs for rented dwellings ($)																
6	COL3	Education - Total Sex / Total - Highest certificate, diploma or degree for the population aged 15 years and over in private households - 25% sample data																
7	COL4	Education - Total Sex / Total - Highest certificate, diploma or degree for the population aged 15 years and over in private households - 25% sample data / Postsecondary certificate																
8																		
9	COL0	COL1	COL2	COL3	COL4													
10																		
11	5390000	0	901	337885	56680													
12	5390001	1	927	3825	670													

STEP TWO: Preparing an Excel File

The Excel file must be cleaned up before it can be used in ArcGIS.

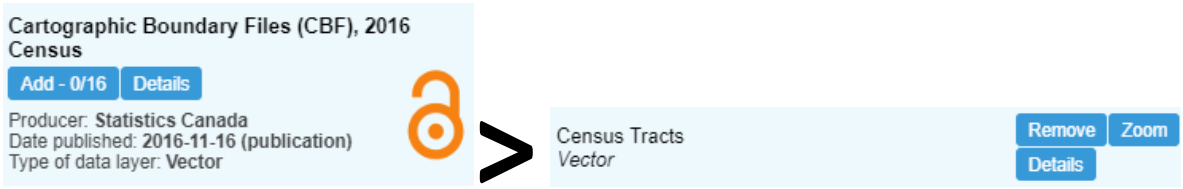
1. Using the descriptions for each "COL" (column), enter a truncated field name in the cells just above the data (e.g. using row 10 in the above screenshot). Field names must begin with a letter, contain only letters, numbers and underscore characters and be limited to 64 characters long. DO NOT INCLUDE SPACES OR SPECIAL CHARACTERS.

9	COL0	COL1	COL2	COL3	COL4
10	CTUID	Ctname	AvgRent	TotalPop15ov	BachelorDegree_higher
11	5390000	0	901	337885	56680
12	5390001	1	927	3825	670
13	5390002	2	1064	5585	1740
14	5390003.01	3.01	806	3930	465

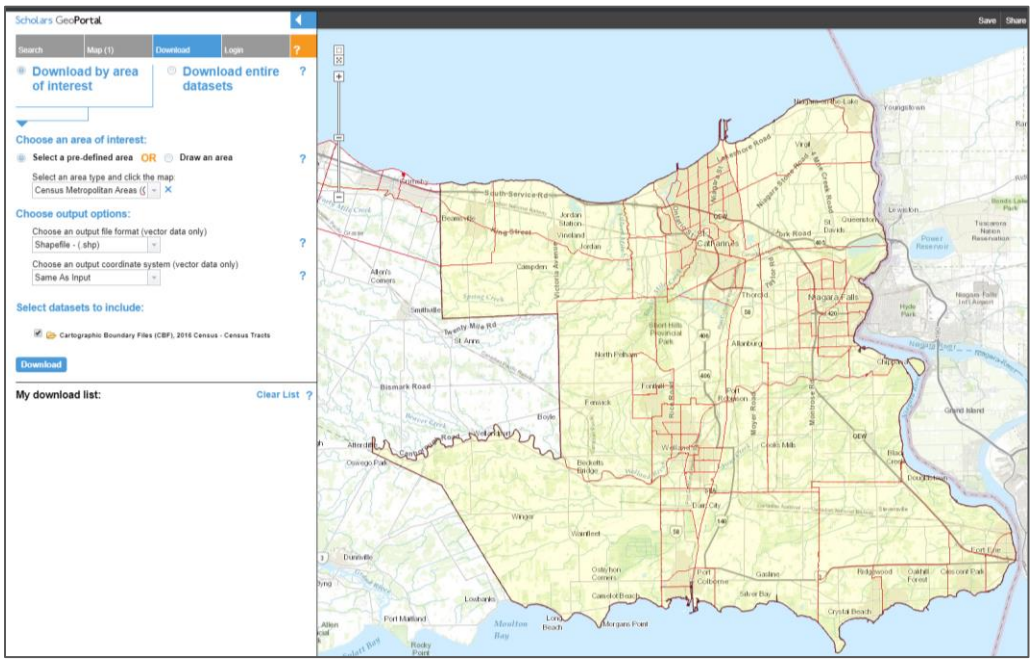
1. Select rows 1 through 9 (in this example) and right-click > **Delete (shift cells up)**.
2. Go to **File > Save as** and save in the format ***Excel workbook*** to your project directory. Be sure to select Excel Workbook as the format. CSV is also acceptable but we'll use the workbook for this tutorial.
3. Close Excel completely.

STEP THREE: Downloading Census Tract Boundary Files

1. Run **Google Chrome** and navigate to **Scholars GeoPortal** (HINT: From the MDGL homepage click on Brock Access beside Scholars GeoPortal)
   http://geo.scholarsportal.info/#r/details/_uri@=749265755$DLI_2016_Census_CBF_Eng_Nat_ct
2. Add the **Census Tract Cartographic Boundary File** to the viewer. Enter the keyword "CBF" (represents Cartographic Boundary File)> **Cartographic Boundary Files (CBF), 2016 Census > Census Tracts**



3. Zoom to Niagara.
4. Click the **Download** tab then select **Download by area of interest > Select a pre-defined area > Census Metropolitan Area (CMA)** then click anywhere over Niagara.



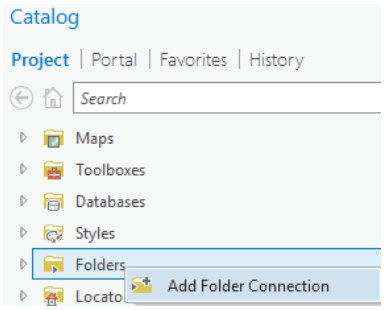
5. Click **Download**.
6. Under **My download list**, right-click the ZIP file and select **Save Link As**... Navigate to the project folder and save.
7. Using **File Explorer** (MY COMPUTER), right-click the zip file and select **Extract All**.
8. Close **File Explorer**. Close **Google Chrome**.

STEP FOUR: ArcGIS Pro – Adding data

1. Run **ArcGIS Pro** and Sign-in when prompted.
2. Create a new project > **Blank**
3. Provide a name for the project (i.e. CENSUS_MAPPING) and browse to the project folder created in a previous step.
4. Click OK.

ArcGIS Pro creates a project file that includes all maps, tools, styles, etc. associated with your mapping project. Maximize the software window.

5. From the **Insert** tab, click **New Map**. Do not click the little down arrow.
6. To open the catalog window click **View > Catalog Pane**
7. Right-click **Folders > Add Folder Connection**
8. Browse to the folder holding the unzipped shapefile and the census data file. SELECT ONLY THE FOLDER. This step creates a shortcut to the folder holding the data files.
9. Expand the new folder shortcut.

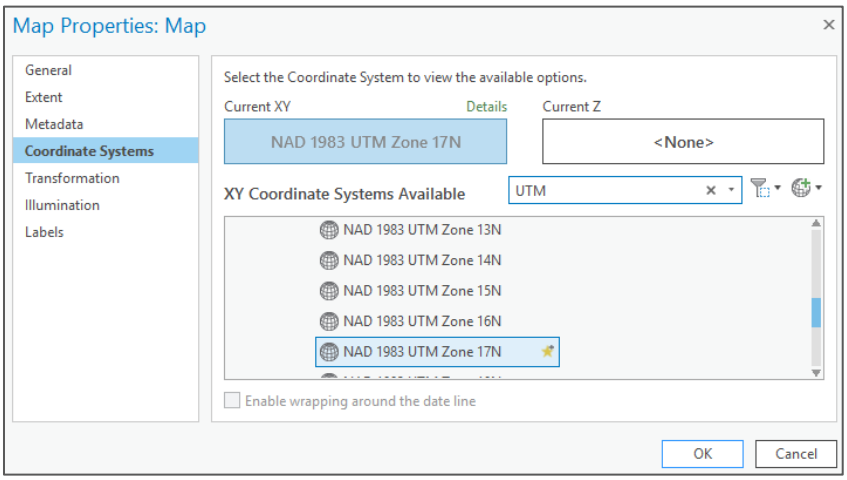


10. Expand the Excel workbook and drag **census$** to the map view. Notice the new table under the Contents Panel.
11. Drag the CT boundary file to the map view.

STEP FIVE: Changing the Projection of the Map View

The map zooms to the extent of the shapefile; that is, the Niagara CMA. The default projection makes the map look tilted. We will set the coordinate system for the map frame next.

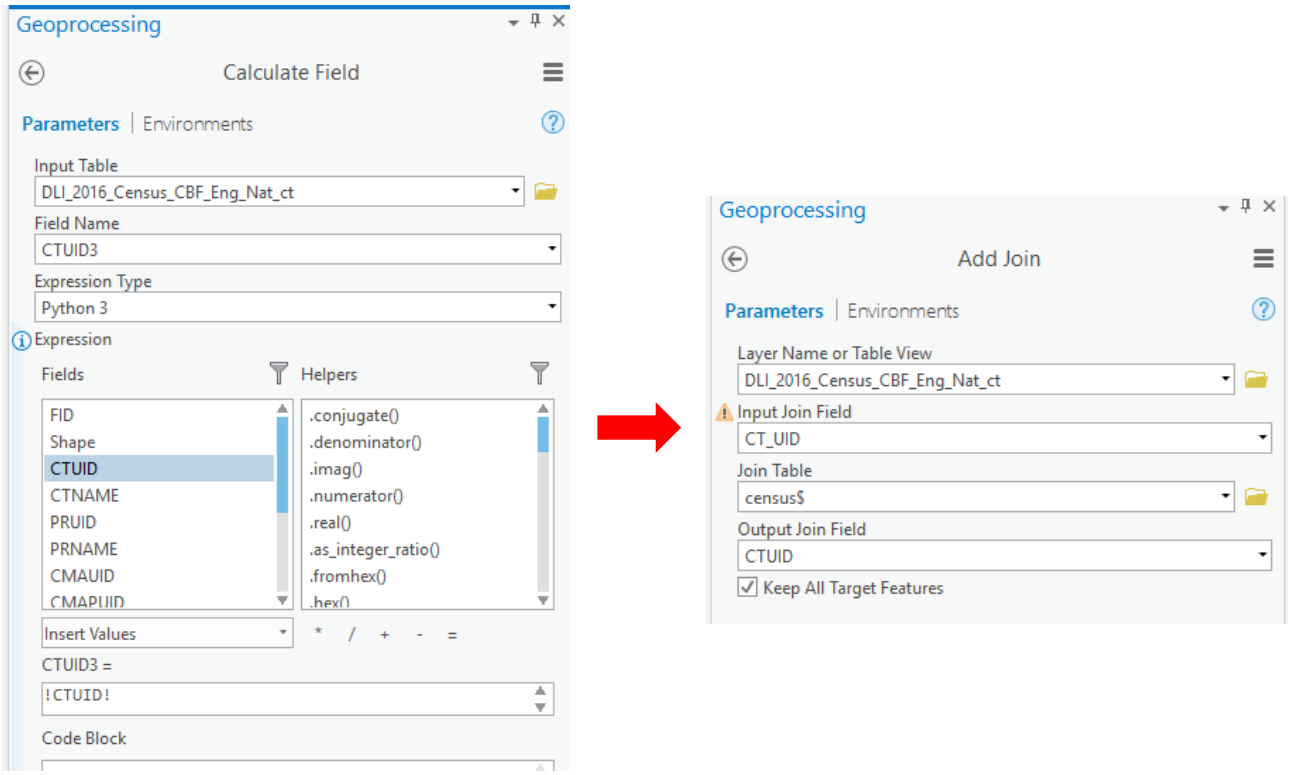
1. From the **Contents** panel on the left, under **Drawing Order**, double click **Map**.
2. Click **Coordinate Systems**.
3. In the **Search** box, enter **UTM**. Hit Enter on the keyboard.
4. Double-click **Projected coordinate system**.
5. Double-click **UTM** then **NAD 1983**.
6. Scroll down and select **NAD 1983 UTM Zone 17N.** Click OK.



STEP SIX: Preparing the Attributes

This step involves joining the census data table to the census tract boundary file based on a common column.

1. In the **Contents** pane, right-click the census tract boundary layer name (i.e.DLI_2016_Census_CBF_Eng_NAT_ct) and click **Attribute Table**. Each census tract is linked with a row of attributes. Notice the column CTUID. This column matches a column of data we downloaded with the census data (GEOUID or CTUID).
2. In the **Contents** pane, right-click the standalone table **census$** and click **open**. The first column in our census data represents CTUID as well. We will perform a join based on CTUID (census tract unique identifier). But first we need to create a new field that will populate the CTUID in the same ***data format*** as the census data.
3. In the **Table view**, click the table header named **DLI_2016_Census_CBF_Eng_Nat_ct**
4. Just below the table header are options for working with the table. Click the **Add** button to add a new field. The view switches to the **table fields view**.
5. Enter a new field name “CT_UID”. This name must be unique from other field names.
6. Double-click the **Data Type** cell and select **Double**.
7. Under **Number Format** click the ellipsis button and choose **Category: Numeric** with **2 decimal places**. Click OK.
8. From the **Fields** tab at the top of the screen, click **Save**.
9. Reopen the attribute table for the census tract layer. Notice the new field added to the far right of the table.
10. Right-click the new field name **CT_UID** and select **Calculate Field**.
11. The goal is to populate the new field with the appropriately formatted CT UID. From the Fields section, double-click CTUID. The expression is automatically populated as follows:



12. Click **Run** at the bottom right. The CT UID attribute field now matches the data type of the census data CT UID.

STEP SEVEN: Joining by attributes

1. In the **Contents** pane, right-click the census tract boundary layer name and select **Joins & Relates** then select **Add Join**. The Add join tool pane is activated to the right of the map view.
2. In this example the software intuitively matches the fields from the shapefile and census attributes. Confirm that the Input Join Field reflects the new field added in the previous section.
3. Click **Run** at the bottom right of the geoprocessing pane.
4. To view the result, activate the table associated with the census data (DLI_2016_Census_CBF_Eng_Nat_ct). It should be docked below the map view.
5. Scroll to the right to see the joined attributes (AvgRent, TotalPop15ov, BachelorDegree_higher).

census$ | DLI_2016_Census_CBF_Eng_Nat_ct

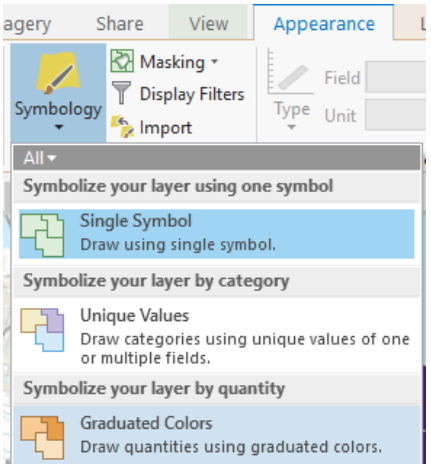
Field: Add Delete Calculate | Selection: Zoom To Switch Clear Delete Copy

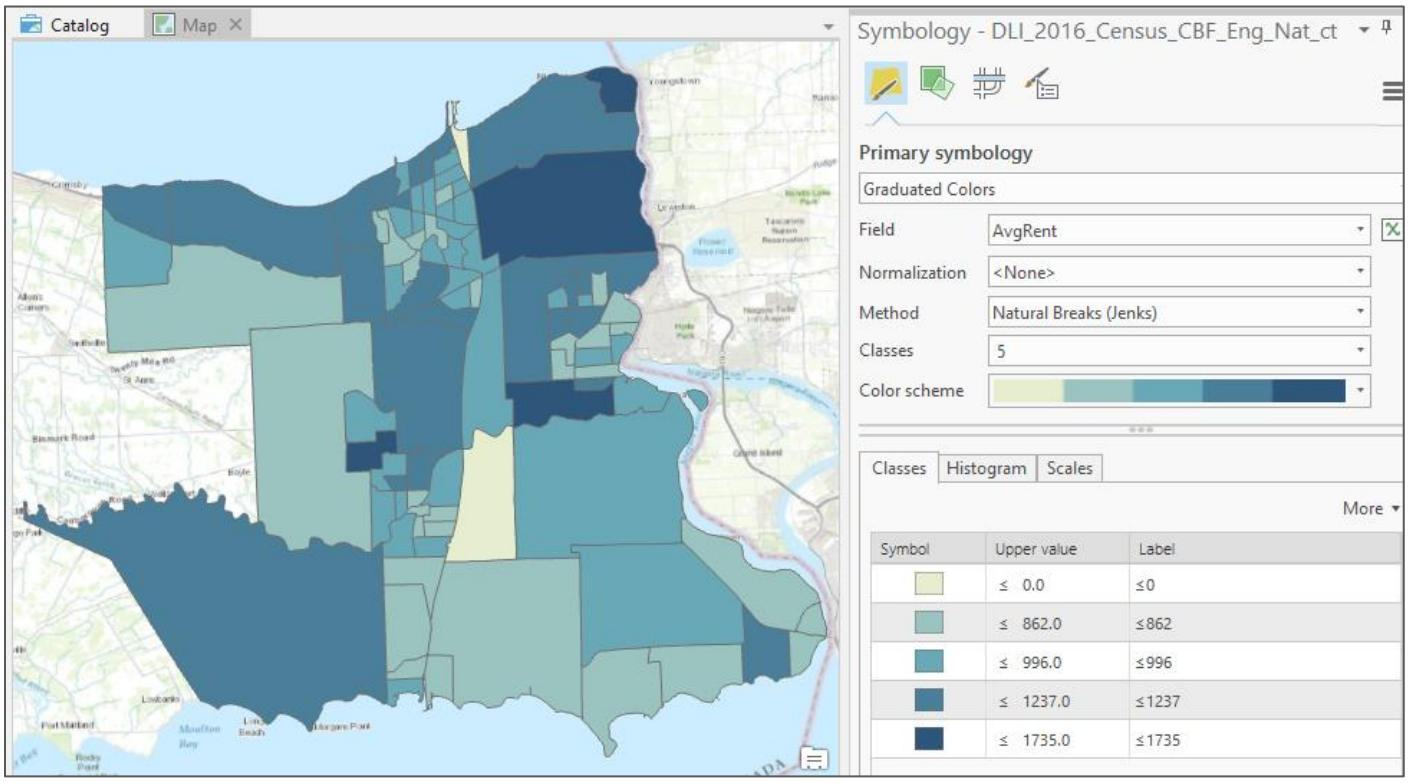
CTNAME	PRUID	PRNAME	CMAUID	CMAPUID	CMANAME	CMATYPE	Shape_Leng	Shape_Area	CT_UID	CTUID	Ctname	AvgRent	TotalPop15ov	BachelorDegree_higher
0209.03	35	Ontario	539	35539	St. Catharines - Niag...	B	7597.968192	2856803.66933	5390209.03	5390209.03	209.03	857	3935	525
0209.04	35	Ontario	539	35539	St. Catharines - Niag...	B	7957.912248	2397743.35313	5390209.04	5390209.04	209.04	860	2735	395
0209.05	35	Ontario	539	35539	St. Catharines - Niag...	B	7095.201324	2941721.83784	5390209.05	5390209.05	209.05	1112	5305	935
0209.06	35	Ontario	539	35539	St. Catharines - Niag...	B	5324.22562	1828627.72906	5390209.06	5390209.06	209.06	953	2620	765
0300.00	35	Ontario	539	35539	St. Catharines - Niag...	B	16608.25258	9463463.34451	5390300	5390300	300	836	1165	100
0301.00	35	Ontario	539	35539	St. Catharines - Niag...	B	10643.172162	5424733.84527	5390301	5390301	301	888	4025	370

STEP EIGHT: Creating a choropleth map

A choropleth map applies a graduated colour scheme based on certain attributes. The first map we will make reflects the average rent.

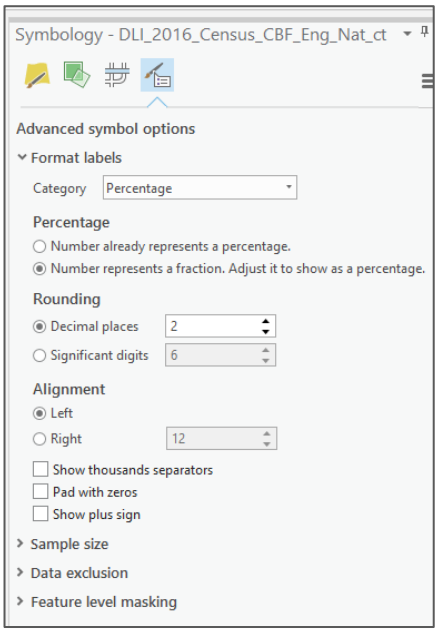
1. Click the census tract boundary layer (DLI_2016_Census_CBF_Eng_Nat_ct) to activate it.
2. Click the **Appearance** tab at the top of the screen.
3. Click the **Symbology** dropdown and select **Graduated Colors**.
4. Beside **Field**, select **AvgRent** from the dropdown list.
5. A default colour scheme is applied to the map where darker colours represent higher values.
6. Click Histogram to adjust class intervals.
7. Click Advanced Symbol Options; Format Labels > currency





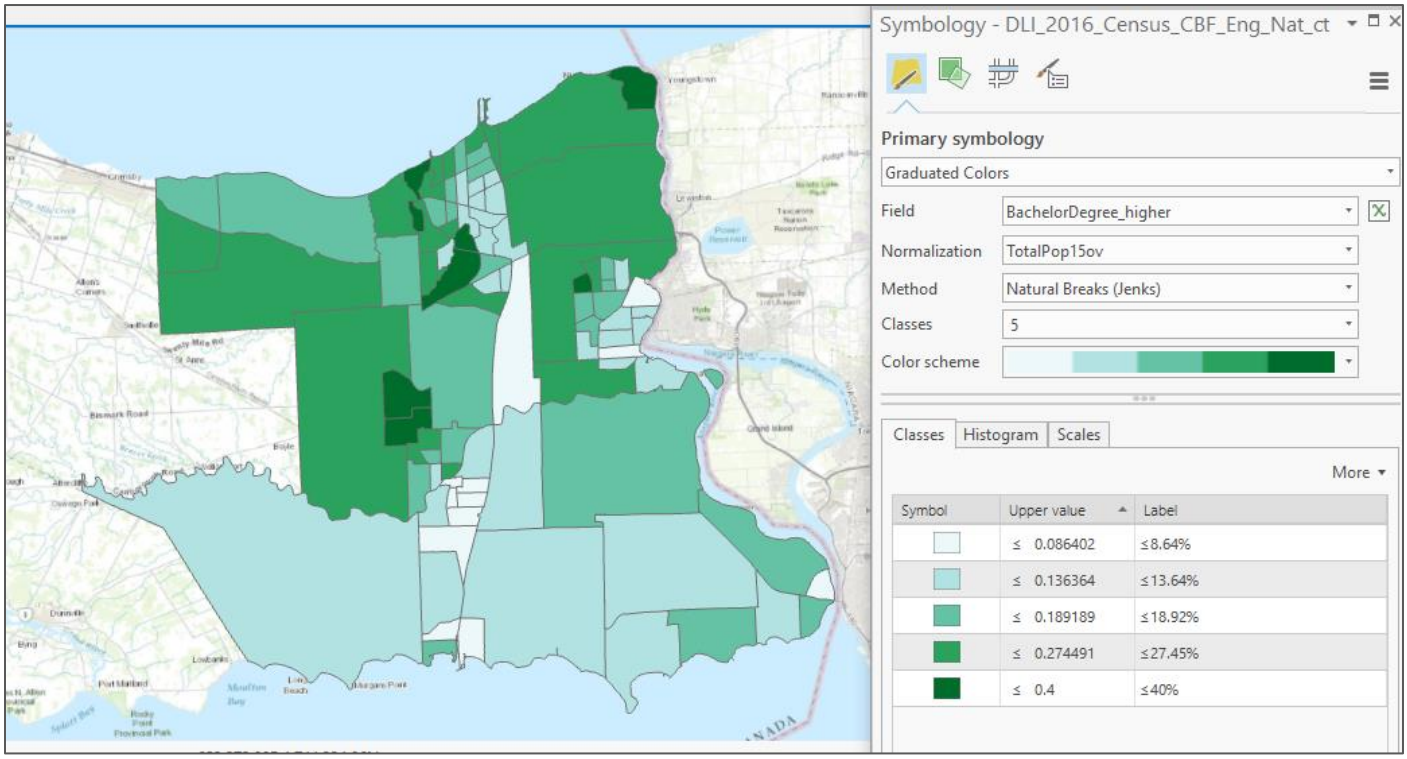
A lot of census data must be represented as a percentage. This is known as 'normalization'. For example, the variable downloaded earlier that represents highest level of schooling as bachelor's degree or higher must be mapped as a percentage of the population 15 and over. Follow these steps to map a normalized value.

8. **Right-click** the census tract layer (DLI_2016_Census_CBF_Eng_Nat_ct) and select **Copy**.
9. In the **Contents** panel, below **Drawing Order**, right-click the word **Map** and select **Paste**. You now have 2 layers representing the census data.
10. Click the topmost layer to activate it. The symbology pane should still be activated to the right of the map view.
11. Change the **Field** option to **BachelorDegree_Higher** (population with bachelor degree or higher).
12. Beside **Normalization**, select **Pop15ov** (total population 15 years of age and older).
13. Select a new colour scheme and see the map reflect your changes.



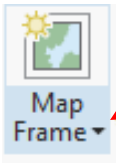
To enhance our understanding of the map we will adjust the legend values to reflect percentages. By default, the number represents a fraction.

14. From the **Symbology** pane, click the advanced symbol options button 
15. Under Format Labels, beside **Category**, select **Percentage**.
16. Under **Percentage**, select **Number represents a fraction. Adjust it to show as a percentage**.
17. Change the number of decimal places to **2**. Notice the changes under the CONTENTS pane to the left of the map.



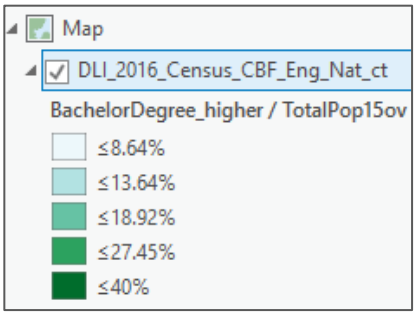
STEP NINE: Creating a Layout and Sharing

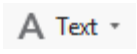
Let's clean up the Contents panel.

1. Rename census layers to reflect the census variable (Average Rent; Bachelor's Degree or Higher)
2. Click the **Insert** tab and select **New Layout**.
3. Select **ANSI Landscape Letter**. A new blank layout is added to the project views.
4. Click the dropdown arrow beside **Map Frame** 

and select the second option that reflects the current map.
5. **Draw a box to add** a map window to the Layout.
6. Click and drag the window to reposition it.
7. Click and drag a corner handle to resize the map. Leave room for other layout elements such as the legend.
8. To change the zoom level of the map, right click the map and select **Activate**. When the map element is active you can use the Explore tool and other zoom and pan tools to customize the display.
9. When you are finished, click **Activated Map Frame > Layout** ribbon at the top of the display and click 

.
10. From the **Insert** ribbon in the **Map Surrounds** group, add a **North Arrow** and **Scale bar**. Reposition and resize the elements as you see fit.
11. From the **Map Surrounds** group, click **Legend** then draw a box on the map where you want the legend to sit. The **Format Legend** panel appears to the right of the Layout view. Options are also available in the Contents panel to the left (turn layers off if you don't want them to appear in the Legend).



12. Click the **Text** tool 

to add customized text including a title and source statement. Explore the text options on the **Format** ribbon.
13. Save your map!

Our map is complete and ready to share!

14. Click the **Share** ribbon at the top of the window. To make a PDF or JPEG, click **Layout**
15. Change the **Save As** type to the format of choice and navigate to your storage space on X:\ drive.
16. Click **Export**.