GEOB 270 Sept 2019

Lab 4: Rental Affordability

Working with Census Data: tables, joins, classification, normalization, visualization

Due: 2 week lab, due at the beginning of your lab time in 2 weeks, Lab is out <mark>of 46 marks</mark>.

Don't forget you can google for GIS and ArcGIS help! For example 'what is a Geodatabase?' or 'ArcGIS What is a Geodatabase?'

Introduction and Scenario

Often geographers need to work with census data that is gathered, analyzed and displayed by national government organizations (example Statistics Canada). Census data is utilized in many geographic analysis research projects: urban planning, immigration, social geography, environmental justice, crime prevention, transportation planning, policy analysis, etc., and all of these topics can be explored using GIS.

Every 5 years, Canadians are surveyed. Previous to the 2011 survey, 80% of the population completed the 'short form' and 20% of the population completed the 'long form', where more detailed information is captured. In particular, the 'long form' included socio-economic data including income, dwelling type and value (the topic of this lab), transportation data such (modes of transportation for commuting) and immigration data. The former Canadian conservative government changed census policy for 2011; the long form was not mandatory but voluntary. This has impacted the quality of the data, and makes it challenging to compare to previous years. The 2011 Census is referred to now as 2011 NHS for national household survey. The next survey was conducted in 2016, with the long form reinstated for 20% of the population, and the data was released in the fall of 2017. The next census will be in 2021.

For this lab, we will use 2016 Census data to assess rental housing cost and affordability in Metro Vancouver and Montreal.

Statistics Canada creates and maintains both map and tabular data. The census map spatial areas are based upon population. In large Census Metropolitan Areas (CMA) like Metro Vancouver, Toronto and Montreal there are 3 different scales, or resolution, for the data: data summarized for the whole CMA, Census Tracts (CT) and Census Dissemination Areas (DA). Statistics Canada draws census boundaries on maps for CT and DA based upon the number of people living in the area. DAs are finer resolution with a DA being sometimes less than a city block, sometimes just an a partment building, whereas CTs are coarser resolution, and one CT makes up a few city blocks.

For this lab, you will learn how to access and download Canadian census data: both spatial maps files for CTs and DAs, and variables in tabular files, and for 2 different cities: Metro Vancouver and Montreal. You will visualize and work with rental cost data exploring various methods for classifying quantitative data (monthly cost of rent) for Metro Vancouver CTs and Das, comparing the monthly costs to Montreal, and then looking at another rental indicator: the percent of people in each DA that spend > 30% of their income on rent.

You are given a scenario that you are currently employed by Globe and Mail, Canada's national newspaper, as a data journalist and need to compile some publishable maps to accompany an article on cost of rental housing in Metro Vancouver, and comparing this to Montreal.

Learning Objectives and Tasks

Part 1 - Developing a working knowledge of Canadian Census Data

- a) Downloading Spatial and Tabular Census Data
- b) Join tabular data to spatial layers
- c) Visualizing rental housing data
- d) Terms of Canadian Census Data collection

Part 2 - Understanding quantitative data classification (for Metro Vancouver CT rental housing cost) Creating a map to illustrate the difference between 4 methods of classification:

- a) natural breaks,
- b) equal interval,
- c) standard deviation and
- d) manual breaks

Part 3 – Working with percent and ratios: Standardizing data for comparison (standardizing shelter cost by income and comparing Metro Vancouver to Montreal).

Setting up your workspace

Generally speaking, when starting any GIS project, you:

- a) set up a workspace (c:\temp\lab)
- b) copy any data into the workspace
- c) create a geodatabase (if using ArcGIS as we are in this course)
- d) Import the data into the geodatabase
- e) Continue with analysis

Part 1 - Developing a working knowledge of Canadian Census Data

Set up a geodatabase called Lab4rental

Launch ArcCatalog. In the ArcCatalog Catalog tree, right-click on C:\temp\lab4 and select New > File geodatabase and name it lab4rental.

You might be wondering what a geodatabase is? In short, it's a file management structure specific to ArcMap that has special functionality. For more information, see ESRI's help page: http://desktop.arcgis.com/en/arcmap/10.3/manage-data/geodatabases/what-is-a-geodatabase.htm

Launch Arc Map.

In the Getting Started window, set your default geodatabase to C:\temp\lab4\lab4rental.gdb. Select the Blank Map template from My Templates and click on OK to begin.

Setting your default geodatabase will help you to avoid losing your data. It will ensure that the output of any analytical operation is stored in lab4rental.gdb as a feature class, unless another location is chosen.

a) Downloading Spatial and Tabular Census Data

One can download this data from Statistics Canada. However, for our lab, you will download the census data from both UBC library (spatial map files) and the University of Toronto census data site (tabular files). These sites have made it easier to download the data. Please note – these sites are only available to you as UBC students. You will find, download and extract:

- 1. Spatial data Metro Vancouver CT and DA census boundary maps, and Montreal CTs for 2016.
- 2. Tabular data shelter rental cost and > 30% income spent on rent for both CTs and DAs

Accessing Census map shapefiles for Canada

We will use the UBC Library.

- Go to the Abacus Dataverse Network (<u>http://data.library.ubc.ca/</u>) and search for 'Census Canada 2016 boundary files'. The page will probably ask you to login.
- This finds the entry to the Census Canada Cartographic boundary files. Click on link and then on "Data & Analysis" tab to download individual files. The link has access to the different census boundary units.
- For this lab, you need to download:
 - lct_000b16a_e.zip which are all the CT boundaries for CMAs in Canada
 - Ida_000b16a_e.zip which are all the DA boundaries for CMAs in Canada
 - and, for background cartography purposes when we make our final maps:
 - lhy_000h16a_e.zip which are the Great lakes, St. Lawrence river and oceans
 - lhy_000c16a_e.zip which are rivers, like Fraser River
 - lpr_000b16a_e.zip which are all the Canadian and provincial boundaries
- copy the 5 .zip files into your workspace c:\temp\lab4
- extract the data in the zip file to the lab4 works pace (not the level below. Do not extract data to your geodatabase.)
- Add layers to the Lab4rental.gdb in ArcCatalog
 - Right-click on **lab4rental.gdb** > Import > Feature Class (multiple)
 - In the dialog window, add all of the shapefiles (5 in total) and click OK.
 - In ArcCatalog, delete the original shapefiles before continuing (all the files outside of the geodatabase).

You should only be left with the geodatabase.

Close ArcCatalog

Open ArcMap and add the 5 layers: CTs and DAs (for CMS in Canada for 2016); provinces; and 2 different water layers.

• Rename the layer name lct_000b16a_e to CanadaCT_2016 (gently left click on layer name until you are allowed to edit name).

- Rename the Ida_000b16a_e to CanadaDA_2016
- rename lhy_000h16a_e to water_ocean
- lhy_000c16a_e to water_rivers
- lpr_000b16a_e to provinces,

QUESTION 1(1)

What is the projected coordinate system of water_ocean, water_rivers and provinces?

You should be able assess from the shape of Canada if the coordinates are projected, or not, and what type of projected coordinate system construction (conic for example).

Zoom into the Metro Vancouver area. Turn on and off the CTs and DA for 2016 – you will get a feeling for the area covered by CTs, coarser resolution, and DAs, finer resolution.

QUESTION 2(1)

Why is Vancouver on a slant?

Extracting out Metro Vancouver and Montreal

Because of the volume of data, and because we are interested in Metro Vancouver and Montreal only, it will be easier for our analysis and mapping to extract into separate layers Metro Vancouver and Montreal.

- Open attribute table for CanadaCT_2016
 - You will click on *select by attribute* icon
- and query for CTs with a CMANAME of Vancouver (CMAs are Census Metropolitan Areas a clustering of municipalities such as Vancouver, Richmond, Delta... that form large urban area)
 - double click on CMANAME;
 - single click on =
 - click on get unique values;
 - double click on Vancouver
 - apply

You should have 478 CTs selected and see them highlighted in blue around metro Vancouver. Now you need to export this selection into a new feature class called **MVanCT** in your lab4 housing geodatabase,

- right click on CanadaCT_2016
- click on data > export data
 - export: selected features
 - use same coordinate system as this layer's source data
 - Output feature class: browse folder icon
 - o Name: MVanCT
 - Save as type: file and Personal geodatabase feature class and ensure that you are in your lab4housing geodatabase.

Add to Arc Map

Once you finish with a selection, it is good practice to *clear the selection*.

- Repeat this process for Montreal Note: Montreal is hard to select because you need the French accent, so either select using unique values, or use the CTUID to select Montreal Name the layer MontCT
- Repeat this process with CanadaDA_2016 for Metro Vancouver only Name the layer MVanDA

Once you have finished this, you should have these layers in your geodatabase to work with for the rest of the lab:

- provinces
- water_ocean
- water_rivers
- MVanCT
- MontCT
- MVanDA

Uncheck CanadaCT_2016 and CanadaDA_2016 to remove them from the map.

Change projection (you did this in lab 2)

The maps of census boundaries are in the default coordinate system from Statistic Canada. Since you have isolated Metro Vancouver you need to change the Canada-wide reference system to local projections. Vancouver is in UTM zone 10.

Changing projection for Vancouver 'on the fly'

Rename the layer dataframe to MVancouver

- Right click on *dataframe MVancouver>properties*; change the projection to NAD 1983 UTM Zone 10. This will draw all of your layers in the local projection for Vancouver.
 Or permanently changing the projection
- for all of your layers: use the *Project* commend under *Data Management Tools* (Arctool box).

Changing the projection for Montreal

- Insert dataframe
- move MontCT, water_ocean, water_rivers and provinces to dataframe
- rename *dataframe* Montreal
- Right click on *dataframe* **Montreal**, *properties*; change the projection to NAD 1983 UTM Zone 18.

To go between dataframes, right click on dataframe name and click activate

Downloading census tabular data from University of Toronto CHASS site

For our scenario, we need to download census tabular data for Vancouver and Montreal Census Tracts (CT) for:

- *median monthly shelter costs for rented dwellings*: median (not average) monthly cost of rent. This data represent tenants, or renters
- percent of tenant households spending > 30% or more of its income on shelter costs

QUESTION 3(2)

What is the difference between median and average? Why for this analysis is it better to use median cost of dwelling and not average?

QUESTION 4(1)

Statistics Canada uses the variable of monthly rent and the variable of household income to calculate what percentage of income is spent on rent. If there are two people who live together and each person has an annual income, does household income include individual or combined income? Click on Income, and then click on housing, and then shelter cost of private households:

https://www.statcan.gc.ca/eng/concepts/definitions/index

University of Toronto has organized census data from Statistics Canada into an interactive easy to use web site (CHASS) that can be accessed through the UBC library:

http://resources.library.ubc.ca/page.php?id=521

Or search for Census Analyser on the "Indexes and Databases" tab through the UBC Library. You will be automatically redirected to a CWL login.

Once at the CHASS site from the Canadian Census Analyser, you have two options – pick tables by geography or year, we will pick by year.

• Under vear you will see 2016



• Then pick Profile of census tracks

On the next page you get taken to:

detacentre.chass.utoronto.ca.ezproxy.library.ubc.ca.'cgi-bin/census/2011nhs/displayCensus.cg	gi?year=20118igeo=ct		
CHASS Canadian Census Analyser 2011 National Household Survey ((NHS) Profiles Files / Profile of Censu:	s Tracts	
		Census @ Census 2011 NHS 2011 Free	nçais 🖪 Help 🝸
Step1: Specify Census Geography for retrieval			
= Census Geography: (1 selected)			
* Locate census geography (CMAs/CAs with CTs) in the database in What is GNP2 and GNP definition	using the following filtering criteria then select the	e items you would like to include in your search.	
sbeck all; ancheck all; a items found: Ø Varies (B C) (2 + 8 or 90) Ø Varies (B C) (22 + 8 or 90) Ø Varies (B C) (22 + 8 or 90)			
Or select all geography			
Step2: Specify NHS profile variables for retrieval			
= NHS Profile: (0 selected)			
Select the NHS Profile variables (.see definitions.) to include in your se	Farch.		
Citizz, Imm, Eth,Relig, Lang,Mobi, Wk,LFS, Ind, rans Hous ic Imm Gen Aborig Edu Occ Wk		-remove all: Selected items:	
-CITEOR AIR: 1 -LINCIPECK AIR-			

- Step 1: Specify Census Geography for Retrieval
 - For geography uncheck A and check V
 - Then check Vancouver and ensure your geography selection box looks like above
- Step 2 Specify Variable for Retrieval

Now you need to pick your Profile Variables for Vancouver, cost of Housing

- Click on *Housing* along the top
 Make sure the vertical bar *Total Sex* is selected
- From the list of variables, check the 2 variables we want, listed under Total -. Tenant households in non-farm, non-reserve private dwellings:
 - 0 median monthly shelter costs for rented dwellings
 - 0 percent of tenant households spending > 30% or more of its income on

shelter costs



- Step 3 Specify output details and submit query
 - 0 Leave everything as it in optional
 - O Under download, click dBase (DBF) file (you cannot read this, but ArcMap can!)
 - o Submit query
 - o Click link to download data file
 - 0 Note: table in this window will give you a list of variable names, make sure:
 - o COL 0 is CT id
 - 0 COL1% tenant household that spend >30% on rent
 - 0 COL2 is median monthly cost of rent
- After you have downloaded the data table, use the ArcCatalog tab to import them into the

lab4housing.gdb by right clicking on the geodatabase > Import > table

• rename MVanrentCT

Repeat this process for Montreal.

- Name file MontrentCT
- After you have downloaded the two data tables, use the ArcCatalog tab to import them into the lab4rental.gdb.

Repeat this process for Metro Vancouver DA.

- note: for DAs, 2016 name you are selecting for is Greater Vancouver.
- Name file MVanrentDA
- Add database files to ArcMap to the relevant MVancouver and Montreal dataframes.

Change column names

- Open attribute table for MVanrentCT, MVanrentDA, MontrentCT
- Right click on COL1 properties ALIAS and change COL1 to per30inc
- Right click on COL2 properties ALIAS and change COL2 to monthlyrent

When downloading tabular variables, you can pick multiple columns of attributes at one time and download the file, if you do this REMEMBER what order you picked attributes and ensure you write down the col1 col2 col3... when you bring into ArcMap or you will forget what col represents what attribute. After you export the data into your geodatabase, you will change column names.

You should now see 2 data frames in ArcMap; in MVancouver you will have a CT and DA spatial layer, and a CT and DA tabular file of rental. In the Montreal data frame, you will have the Montreal CT spatial layer, and the Montreal CT tabular file of rental.

b) Join the tabular data (of census information, or dbf files) to spatial layers (CTs and DAs) for GIS analysis and display

You now have to join the Metro Vancouver map or spatial files to the database files of shelter and income. COLO in your database files are the unique identifier for the CTs that match to the CTUID in the map files. Join the data to the map with these identifiers:

- Right click on **MVanCT** *joins and relates join*
 - O In the join window:
 - 1. Field (or item/variable) to be used for join is CTUID
 - 2. Table is MVanrentCT
 - 3. Field in table is COL0
 - Keep only matching records



• Open the attribute table of **MVanCT** – view fields. You should see per30inc and monthlyrent at the end in COL1 and COL2

Repeat the join for:

• MVanDA using DAUID as the join item

Repeat the join for:

• MontCT using CTUID as the join item NOTE: Activate Montreal dataframe first

Joins like this are only temporary, so, in order to save this work of the joins, we recommend that you save the joined layers to a new layer in order not to lose the selection and the join.

- Right click on layer
 - Data
 - Export data
 - use defaults except for name change Export_Output to the names of the three layers that have joined tables by adding 'join' at the end.
 - Now you should have the following layers:
 - MVanCTjoin
 - MVanDAjoin
 - MontCTjoin

Change column names

- Open attribute table for MVanCTjoin, MVanDAjoin and MontCTjoin
- Right click on COL1 properties ALIAS and change COL1 to per30inc and COL2 to monthlyrent

SAVE YOUR WORK: rental.mxd

Finished getting DATA! So you have

- accessed spatial map files for Canada for CTs and DAs
- reselected out for Metro Vancouver and Montreal .
- You have downloaded MVan rental data for CTs and for DA, and for Montreal CTs
- you have joined these tables to the map files, and saved them as layers!
- You have renamed attribute names and
- You have also added the spatial and tabular data to your geodatabase.

c) Displaying rental data

For **MVanCTjoin**, symbolize rental cost by clicking:

- Properties
- Symbology
- Quantities (quantities is for quantitative data and categories is for nominal qualitative data)
- Value is shelter
- Use defaults

You can add and symbolize other layers (water, provinces etc) and next in the lab you will look at different options for classification and symbolization.

Now do the same for the MVanDAjoin, using the same symbology.

You have some zeros.... How can there be no rental cost of housing? Read on.

d) Understanding Census Data

Creating a national census survey, gathering the data, analyzing the data and creating the results is a complex process. There are various topics that are of necessary interest when accessing and mapping census variables such as the date, the error and accuracy of the data, the survey techniques, the confidentially or suppression of data within census areas if too few respondents. Statistics Canada has an extensive (and somewhat confusing) web site with all definitions.

Variable definitions

For example, in Question 4, you went to the site to view the definition of variables. https://www.statcan.gc.ca/eng/concepts/definitions/index

Delineation/creation of census geography/areas

The following link gives you Statistics Canada definitions for Geography, meaning the spatial areas of census aggregation: including Census Tracts (CT) and Dissemination Areas (DAs) <u>https://www12.statcan.gc.ca/census-recensement/2011/ref/dict/top-them-index-eng.cfm</u>

QUESTION 5(1)

Approximately how many people are in each Census Tract (CT)?	 Commented [WU1]: 2,500-8000
	· /	

QUESTION 6(1)

Approximately how many people are in each Dissemination Area (DA)?

Data suppression and data confidentiality

Statistics Canada has rules for data confidentiality. https://www12.statcan.gc.ca/nhs-enm/2011/ref/DQ-QD/guide_2-eng.cfm

QUESTION 7(2)

Statistics Canada has rules for data (area) suppression (i.e. not publishing the results of cens us information in certain census areas). What is the minimum number of survey responses or people in a census area that is required in order for statistics Canada to publish the data variable averages for that area?

QUESTION 8(2)

For the MVanCTjoin, how many have a "0" recorded for monthly rental cost? What percent of Metro Vancouver CTs do the '0's represent?

QUESTION 9(2)

For the MVanDAjoin, how many 2016 DAs have 0s? What percent of DAs does this represent? Why are there so many more DAs than CTs that have 0s for rental data?

QUESTION 10(1)

Commented [WU3]: 40

Commented [WU2]: 400-700

What may be a reason that there are so many CTs and DAs that have no publishable data for rental **income**?

QUESTION 11(3)

In summary, discuss some pros and cons for using CTs versus DAs for GIS analysis of census data.

Part 2: Understanding quantitative data classification

Creating a map to illustrate the difference between 4 methods of classification:

- a) natural breaks,
- b) equal interval,
- c) standard deviation and
- d) manual breaks

Methods for classifying dwelling cost for Metro Vancouver CTs

There are many different methods to classify quantitative data. The default method in ArcGIS is natural breaks —which looks for natural groupings in the data, as observed in plotting a histogram of the data, to come up with a classification based on the number of classes that you specify. The default number of classes is 5. You will often see results of GIS analysis that simply use these defaults. Unfortunately, natural breaks is always the most accurate or appropriate method of classifying data. For this section of the lab, you will classify rental cost with 3 automated methods: Natural Breaks, Equal Interval and Standard Deviation, and then you will use Manual Breaks to add your own class breaks instead of computer generated class breaks. You will compare all of your results. We will use median monthly cost (monthlyrent, COL2) as our variable.

Eliminate areas with 0s as the cost of rent.

As discussed in the previous section, there are many CTs and DAs that have had data suppressed. These areas are defined by 0s (zeros) in the data. Including these 0s in your data classification is an error – obviously there are no areas where the median cost of rent is 0.

Therefore, you need to first *select by attribute* only areas that contain values > 0 any time you classify census data maps BEFORE you create your classifications.

For MVanCTjoin, and MVanDAjoin and MontCTjoin:

Select for only areas with >0 values

- open attribute table > select by attribute COL2 or monthlyrent > 0 create a new layer with only records for selection
- right click on layer > Selection > create a layer from selected features
- rename selection
- the new selected layer will appear in the list of layers, slowly left click and rename layer to MVanCTjoin_rent – repeat for DAs and Montreal

a) Map 1: Natural Breaks (Default Classification, 5 classes)

- Insert a new DataFrame
- Rename the dataframe rent_NB (for natural breaks)

Commented [WU4]: Many CTs and even more DAs are not rental but owner dwellings. Many rental spaces may be unofficial (such as basement suites) there not captured in the census. Aboriginal lands, or Indian Reservations are not part of the Census thus those areas have 0s (there are a few in Metro Vancouver.) Accept any of these answers.

- Copy the MVanCTjoin layer to the new data frame
- If the layer is not projected properly, you need to go into *DataFrame properties* and project the coordinates to UTM zone 10
- Go to Layer Properties Symbology and click on Quantities and graduated colours. Ensure that the classification method is Natural Breaks and that the number of classes is 5
- Symbolize with a colour ramp or your choice pick one that goes from light to dark to help the map read understand this quantitative data.
- Click on *Classify* and review the histogram

b) Map 2: Equal Interval Classification

- Insert a new DataFrame
- Rename the dataframe 'rent_El' (By slowly left clicking twice on the layer title)
- Copy the MVanCTjoin layer to the new data frame
- If the layer is not projected properly, you need to go into *DataFrame properties* and project the coordinates to UTM zone 10
- Go to Layer Properties Symbolize and click on Classify and ensure that the classification method is Equal Interval and that the number of classes is 5. Check that the exclusion of 0s is still active (it should be).
- Symbolize with the same colour ramp.
- Look at the histogram. It should be clear why the classification method is called Equal Interval.

c) Map 3: Manual Breaks

- Insert a new DataFrame
- Rename the dataframe 'rent_MB' (By slowly left clicking twice on the layer title)
- Copy the MVanCTjoin layer to new data frame
- If the layer is not projected properly, you need to go into *DataFrame properties* and project the coordinates to UTM zone 10
- Ensure that the classification method is Manual and that the number of classes is 5
- Under Break Values, insert the following breaks:
 - 500
 - 1000
 - 1500

2000

Your last break should automatically go to the highest value in your dataset

- Check that the exclusion of 0s is still active
- Symbolize with the same colour ramp.
- Look at the histogram

d) Map 4: Standard Deviation Classification

- Insert a new DataFrame
- Rename the dataframe 'rent_SD' (By slowly left clicking twice on the layer title)
- Copy the MVanCTjoin layer to the new data frame
- If the layer is not projected properly, you need to go into *DataFrame properties* and project the coordinates to UTM zone 10
- Ensure that the classification method is Standard Deviation. It will then automatically change the number of classes to one standard deviation, but the number of classes will vary depending upon the distribution of the data. Think about this.
- Use the default symbology for Standard Deviation
 - Look at the histogram of class breaks

Create a layout view of all 4 classification methods for MetroVancouver CTs

Create 4 maps in layout view

- Click on View layout
- Use the portrait view and display your 4 classification maps at a scale of a pproximately 1:800,000 to 1,000,000
- Add a text box with the classification method used for each map
- Add scale bar, north arrow (Note: You only need one scale bar & north arrow, just ensure that
 all data frames are set to the same scale), legend (make sure each data frame has a legend, and
 the legend is the one that corresponds to that data frame), name, coordinate system info and
 data source. All the standard map elements.
- Save the map as lab4dataclass.mxd

QUESTION 12(10)

• Export the mxd of the 4 classifications as a PDF called "lab4dataclass.pdf"

QUESTION 13(4)

Since you are a journalist, putting together maps of rental cost in Metro Vancouver, which classification method would you choose for your audience and why?

Create a housing cost map comparing Metro Vancouver and Montreal

You are going to create a pdffor publishing in the Globe and Mail of 2 maps which compare Metro Vancouver and Montreal rental costs. These maps will not just be the outline of census areas, but will include water features – so the layers that were downloaded at the beginning of the lab:

- Ihy 000h16a e.zip which are the Great lakes, St. Lawrence river and oceans
- lhy_000c16a_e.zip which are rivers, like Fraser River
- lpr_000b16a_e.zip which are all the Canadian and provincial boundaries
- Activate the Montreal dataframe
 - symbolize Montreal rental using the same manual breaks classification as Vancouver.
- Convert your view to layout
- Edit the legend values (in symbology edit labels) to round them to make them more readable
- Include in your layout:
 - O Title and sub-titles
 - O Legend
 - o Scale
 - o North arrow
 - o Source statement
 - o Name

Save your work to a new name: rentcostVM.mxd

QUESTION 14(6)

Export your map as a PDF called "rentcostVM.pdf"

QUESTION 15(3)

Commented [WU5]: Answer – manual breaks as audience is general public, newspaper readers – have breaks that make sense. Other answer to accept is natural breaks because it is the most error-free. Accept both, or one or the other...

Why should you use Manual Breaks, rather than Natural Breaks, to compare two cities such as Montreal and Vancouver?

Part 3: Working with percents and ratios to compare datasets

So far we have looked at the monthly rent cost in Vancouver and Montreal. We will now consider another indicator: cost of shelter in relation to income, how much of a total household income goes towards rent. These types are indicators are important to determining affordability – not only the cost of shelter for individuals, but in relation to income. For example, in some sectors, like accounting, the salaries are lower in Vancouver than Toronto, but cost of rent are not lower in Vancouver than in Toronto, so, for this case, affordability is LESS in Vancouver than Toronto – shelter same, but income lower.

Any household which spends 30 per cent or more of its gross income on housing has affordability issues, according to the Canada Mortgage and Housing Corporation.

Create a rental affordability map for Vancouver CTs

Open the rentcostVM.mxd if it is not already on your screen. Save as "affordabilityVM.mxd"

Eliminate areas with 0s as the value for percent or COL1

As before, you first have to eliminate the zeros now from a different data variable, the *per30inc* or *COL1* For MVanCTjoin, MontCTjoin:

 ${\it Select for only areas with > 0 \, values}$

- open attribute table > select by attribute COL1 or per30inc > 0
- create a new layer with only records for selection
- right click on layer > Selection > create a layer from selected features

rename selection

- the new selected layer will appear in the list of layers, slowly left click and rename layer to MVanCTjoin_per30inc – repeat for Montreal
 - For MVanCTjoin_per30inc > properties > symbology > quantities > graduated colors
 - 0 Value per30inc or COL1
 - O Classify > Manual
 - 4 classes
 - Break Values
 - 20
 - 40

60

Last value will be highest value in ratio

- 0 **O**K
- Change the class colours to a colour scheme that shows various levels of unaffordable

Create an affordability map for Montreal CTs

• Follow the same steps as you did for the Vancouver CTs

$\underline{Create\ publishable\ maps\ comparing\ affordability\ Vancouver\ to\ Montreal\ using\ Affordability\ percent$

- Convert your view to layout
- Create a layout of Montreal and Metro Vancouver affordability
- Include water layers
- Include in your layout:
 - O Title and sub-titles
 - O Legend
 - o Scale
 - o North arrow
 - O Text box explaining the data variable, and therefore what is being mapped and highlighted
- Save your work to affordabilityVM.mxd

QUESTION 16(6)

• Export your layout as a PDF called "affordability.pdf"

PORTFOLIO POST (lab4)

The answers to the following questions will be marked at the end of term on the portfolio.

1. Quantitative Data Classification

Post your pdf of the 4 dataclassification methods for cost of median monthly rent in Vancouver and a post which reflects you knowledge of how different methods of data classification influence the interpretation of data on maps.

2. Cost of Rental in Vancouver and Montreal

Post your pdf of rental costs comparing Vancouver and Montreal.

Explain in your post what data this represents: source of the data, the variable, no data areas, and any other error and uncertainty issues using this variable.

3. Affordability of Shelter

Create a post for your portfolio that includes your 2 pdfs of the maps comparing Affordability of Rent as compared to Income in Vancouver and Montreal (percent of households that spend > 30% of income on rent)

Explain in your post:

What is affordability measuring, and why is it a better indicator of shelter affordability than rental cost alone? Is affordability a good indicator of a city's 'livability'?