Using Census Mapper

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Understanding The Hierarchical Nature of Statistics Canada Data

Geographic Files and Data Files

Getting a folder for your map assignment

As with everything in this course, it is very useful to set up a folder with an RStudio project folder specifically for your map assignment. I have already actually created one on the course GitHub page. If you are able to to pull changes from the DMJN328 course page in GitHub, by following the instructions here, then you should see a folder called "map assignment" in your course folder.

Open the .Rproj file with RStudio.

If not, make your own folder in the course folder, call it whatever you want and make an RStudio Project file in that folder.

Using Census Mapper

Census Mapper is an open source project that makes it easier to access Statistics Canada's vast troves of census data and link it to geographical files for Canada to make it easier to visualize Canadian census data. It is meant to work seamlessly with R.

Installing the package and loading the library

As with everything, we need to install packages and load them. Open an R Script (or you can open the pre-made cancensus_tutorial.R script that is in the `map assignment` folder)

You can start with these commands to install census mapper and load the library.

Note, any code snippets that appear in this document are formatted so that you should be able to copy and paste them into an R script.

```
install.packages("censusmapper")
library(censusmapper)
```

Getting an API

While it is free and open source, it is necessary to register for an API. Click on the top-right of the website to login and get an API.

The API should look something like this.

Using your API in R

There are two ways to make your API: temporary and permanent.

Temporary

The temporary way is to insert the following command at the top of any script you write that interacts with census mapper. Of course, you need to insert your own API key after the = sign. The one below is a modified version of my own, so it won't work.

```
options(cancensus.api_key = "CensusMapper_287500bb91a374ec69fdcf27")
```

After that, any commands you run in that script will interact with Census Mapper nicely.

The downside to the temporary approach is: 1) you need to do it every time you write a script to get data or files from Census Mapper and 2) if you share your code with anyone then you will expose your API. It's not a big deal, but it's something.

Permanent

The permanent approach sets your cancensus API inside R permanently, or as long as you have this computer. The way you do it is to open an invisible file called `.Rprofile` on your computer and insert the options command in there.

The following command opens `.Rprofile` (or makes it if it does not already exist). This is what mine looks like. Lines 1:3 are just notes for myself, line 4 is a little command that I use frequently and lines 5 and 6 are my cancensus options.

```
file.edit(file.path("~/.Rprofile"))
```

So, in your `.Rprofile` file, just plunk the `options()` command with your api key, just like this and save it.

```
options(cancensus.api_key = "CensusMapper_287500bb91a374ec69fdcf270fb2")
```

CensusMapper Cache

As you can imagine, downloading geographic files and Statistis Canada data can involve quite a lot of data. This can: a) take a long time and b) overload CensusMapper and Statistics Canada. To minimize the burden on everyone, it is recommended (but not necessary) to also set a *cache* for census mapper data.

A cache is just like a food cache; a place to store something you might need in the future.

So, in this case, you set a cancensus cache as directory on your computer. When you download data from cancensus once, then it will be stored there; if you need to run your script again, the cancensus package will *first* look in the cache to see if it is there, allowing you to not go through the hassle of downloading the information from the internet again. This step is *optional* but, for obvious reasons, recommended and will probably make your life easier.

You set the cache directory the exact same way as setting the API.

Note that you get to choose where you want to put your cache. I find it pretty unobtrusive just to put it in your user directory, but it's up to you.

To set it *temporarily*, enter this command at the top of your script. Note the ~ is Mac-speak for the user's home directory. This *should* work on a PC, but it might not. You *might* need to play with this a little bit, if you have a PC.

```
options(cancensus.cancensus.cache_path = "~")
```

To set it *permanently*, enter the same command in your `.rprofile` folder, save and restart.

If you have gone the permanent route and modified your .Rprofile file, you need to restart RStudio for the changes to take effect

Getting the data out of Census Mapper.

Now we can go over to to get our geography and data files.

Remember that to make our map, we need both some geography files and some data to visualize.

Geography

To select the geographic boundary files you want to work with, play with the cursor to zoom to a region you are interested in.

If you click on "Region Selection" you can zoom quickly to different levels of geography, e.g. Province, census division, census sub-division, census metropolitan area, whatever. I find this convenient.

When you have a geographic boundary area that you are interested in playing with, select it and it should turn orange.

Please note: when you select a geographic region, you will still be able to get the boundary files and data from *sub-units*. So, in the image, I have selected Ontario, but at the next step, I will be able to get data and boundaries on sub-units (e.g. census sub-divisions for all of Ontario), but I have excluded other provinces.

So this is a choice you get to make. One thing to keep in mind, the larger the geographic unit that you select, the more data you will be downloading.

I am going to select Kitchener, so I'm going to zoom in on the Census Metropolitan Area level, drag the map to about the KW area and select Kitchener.

Note that I had to select "Clear Selection" first to deselect Ontario, and then select "Kitchener".

If I jump over to "Overview" I'm going to get a screen that looks below. There's some useful information here.

Notice under "Selected Variables" it says `vectors=[]`. That is because we have not yet selected any data to download.

And under "Selected Regions", it says that we have selected Kitchener (CY) and that `regions={"CSD":["3530013"]}`. `The`regions‘ stuff is code for Census Subdivision (CSD) 3530013.

The more you play with STatistics Canada's data, the more you will learn how it works, but basically, the CSD code is made of a province code (Ontario = 35), a two-digit Census Division code (Waterloo Region = 30) and a four-digit Census Sub-division code (City of Kitchener = 0013).

So, Statistics Canada has a very systematic way of coding Canada's geography. Kitchener is always through all of StatsCan coded as 35300013.

Under Geographic Aggregation Level, there isn't really anythign selected.

Here, we can select what level of data we want to visualize and what boundaries we want to draw. Because we have only selected the City of Kitchener (which is a Census Sub-Division) there are only three options that we can download: 1. CSD (Census Subdivision) which will download the outer boundaries of the CSD Kitchener 2. CT (Census Tracts) which are about maybe ward-level boundaries inside the City of Ktichener 3. DA (Dissemination Areas) which are almost block-level boundaries inside Kitchener.

Obviously option 3 will give us the most fine-grained view of the City of Kitchener, but you might not get as much data.

I raised this in class the ohter day, but in looking at it, I see that there actually is quite a lot of data. So, let's do it.

Let's select DA.

Then go back to overview. If you look at the bottom, there is some R code there and it should look just like this.

```
census_data <- get_census(dataset = "CA16", regions = list(CSD = "3530013"), vectors = c(),
    labels = "detailed", geo_format = NA, level = "DA")
```

I am going to modify it slightly and comment it so we know what is going on.

```
#Instead of saving it as census_data, I am saving it as kitchener, for ease of memory.
#dataset="CA16" says get data or boundary files from the 2016 Census
kitchener<- get_census(dataset='CA16',
#The regions argument lists what regions we are downloading and clearly we are downloading CSD 3530013
#The vectors argument is empty because we are not downloading any data, just boundary files.
#We will come back to this shortly.
regions=list(CSD="3530013"), vectors=c(), labels="detailed",
#We need to change set the geo_format to be "sf"
#Please take note of the warning at the bottom of the R code on the website, it asks you to do this.
#and we are downloading the level of Dissemination ARea
geo_format="sf", level='DA')
```

This should leave us with an object called `Kitchener` in our environment.

Try this command.

```
library(tidyverse)
glimpse(kitchener)
```

```
## Observations: 314
## Variables: 11
## $ `Shape Area` <dbl> 0.78200, 0.33188, 0.56447, 0.18680, 0.16206, 0.15935, ...
## $ Type         <fct> DA, DA, DA, DA, DA, DA, DA, DA, DA, DA, DA, DA, DA, DA...
## $ Dwellings    <int> 230, 191, 254, 210, 199, 223, 306, 283, 185, 360, 226,...
## $ Households   <int> 223, 168, 244, 210, 194, 217, 284, 268, 185, 357, 215,...
## $ GeoUID       <chr> "35300097", "35300098", "35300099", "35300100", "35300...
## $ Population   <int> 588, 402, 552, 491, 425, 513, 584, 532, 459, 530, 374,...
## $ CD_UID       <chr> "3530", "3530", "3530", "3530", "3530", "3530", "3530"...
## $ CSD_UID      <chr> "3530013", "3530013", "3530013", "3530013", "3530013",...
## $ CT_UID       <chr> "5410024.00", "5410024.00", "5410023.00", "5410023.00"...
## $ CMA_UID      <chr> "35541", "35541", "35541", "35541", "35541", "35541", ...
## $ geometry     <MULTIPOLYGON [°]> MULTIPOLYGON (((-80.49342 4..., MULTIPOLY...
```

So there you have it: the dissemination area boundary files for the city of Kitchener. There are 314 observations (rows) of 11 variables. We can go through them one-by-one beause it is quite informative.

1. `Shape Area` - I *think* this is the size of each dissemination area.
2. `Type` - is a factor (fct), and it just says that each row is a dissemination area (DA)
3. `Dwellings` - integer (int) variable that says how many dwellings are in each DA
4. `Households` - integer (int) variable that says how many households are in each. I don't quite understand the difference; one would have to read some documentation at Statistis Caanda.
5. GEOUID - character (so not a number) . From the looks of this, this looks like it is the unique identifier for each dissemination Area (more here)
6. Population - Integer (int) variable showing the population of each DA
7. CD_UID - variable showing the census district identifier `35` for Ontario and `30` for the Census District of Region of Waterloo
8. CSD_UID - variable showig the Census sub-division identifier:`35` for Ontario and `30` for the Census District of Region of Waterloo, and `013` for the CSD of Kitchener
9. CT_UID - variable showing the Census Tract identifier for the CT that each DA is in. 10.CMA_UID - variable showing the ID for the CMA (Census Metropolitan Area) that each DA is in. Kitchener-

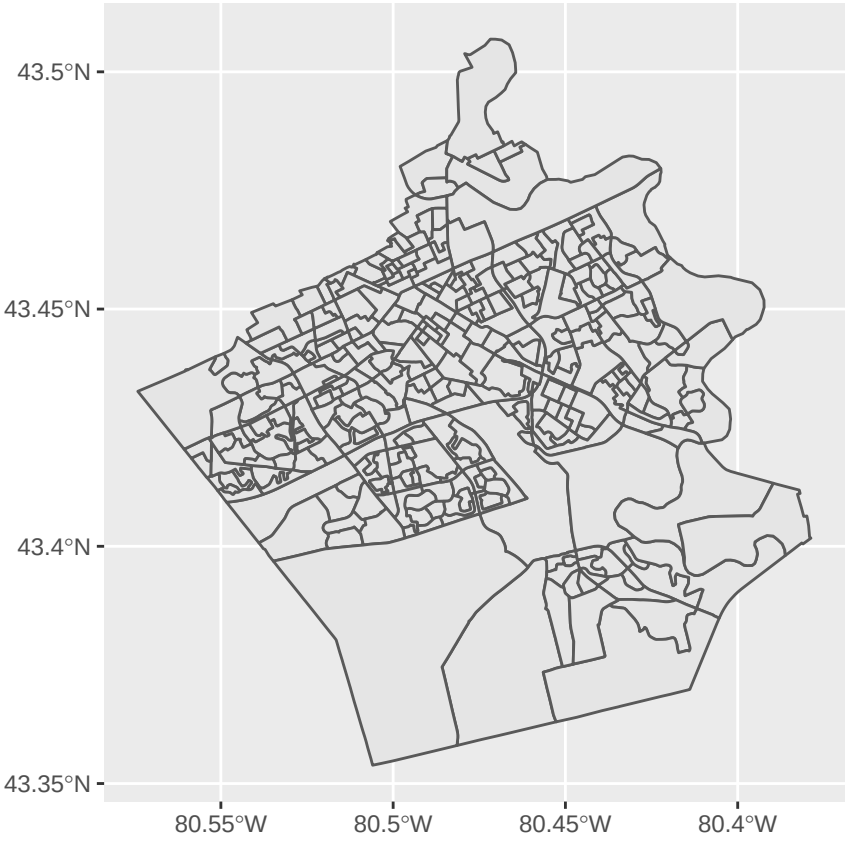
Waterloo-Cambridge is the CMA 35541 (`35` for Ontario and `541`) for all of K-W-C.

10. geometry - there it; those are the geometry coordinates for each of the DAs.

Drawing the map

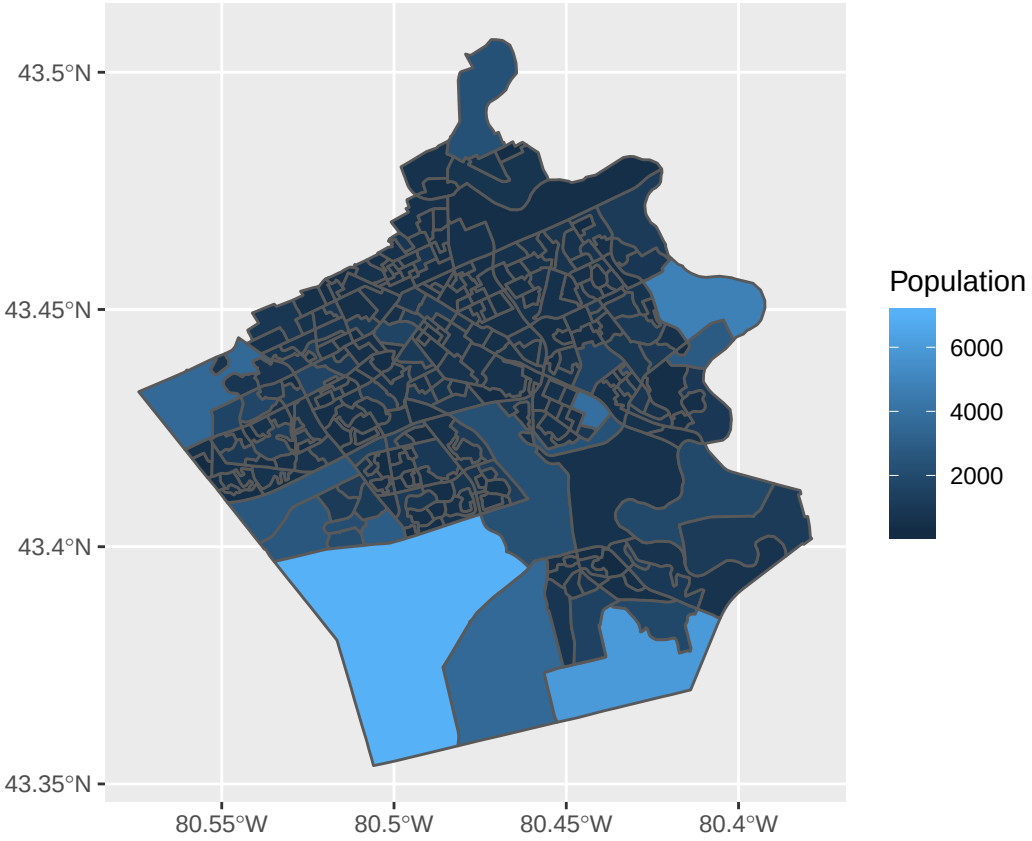
Now it should be dead easy to draw the map, because it's *exactly the way it works in the lesson.*

```
library(ggplot2)
ggplot(kitchener, aes(geometry = geometry)) + geom_sf()
```



When you download the boundary files for a region, it looks like you get basic population data. So with just this command, we could fill in each DA with the population #s exactly the way that we did with the boston data in the exercises.

```
ggplot(kitchener, aes(geometry = geometry, fill = Population)) + geom_sf()
```



I'm going to stop there, because we've practiced different ways of gussying up the map in the exercises, and it's pretty easy.

The next section talks about how to add different variables, other than population via `cancensus`

Data

go back to the web browser and click on "Variable Selection"

Honestly, this product is so incredible it kind of makes your head spin. Bear with me.

Note that there are two categories at the top: `100% Data` and `25% Data`. The difference between the two is that the first is the results from *every single household and person that filled out the census* and the second is the results of sample drawn from the full census (25% of the results). So, it is a *huge* sample and extremely accurate, but it is still just a *sample*.

Some variables are only released with sample data, basically out of privacy concerns (I think).

You can search by keyword, or browse through by topics.

There are a few things to really note:

1. Each variable appears to be summarized by sex. That is, if you want you can track the results of each variable in the sense for men, women or total (if you do not care to differentiate by sex.)
2. Each variable has a code attached to it that starts with a `v`. e.g. The Total age variable is `V_CA16_1`. `V` stands for `vector`, `CA16` is the 2016 Census and `1` is just the identifier of the census.

Now, we're not going to get that vector, because all it will download is the Total number of people who provided Age data to the census.

Click on it and you'll see that it expands into more categories, with more vectors. Now, there is a female 0 to 14 years vector, a male 0 to 14 years vector and a total 0 to 14 years vector.

So those three vectors will provide us with the number of females, males and total (both sexes) 0 to 14 years old in each dissemination area in Kitchener.

You can click on the 0 to 14 years vector as well and you see that you get finer-grained vectors. Now you have the number of 0 to 4 year olds, 5 to 9 year olds etc, for males and females and total (both sexes.)

Click on 0 to 4 one more time and you see you get right down to the one year category. Note: not all variables in the census will have vectors with this level of detail.

For now, let's just select the vector that has the total number of 0 to 4 year olds. This will tell us where the toddlers live in Kitchener. Clicking on a vector selects it, and it should appear in the text box above the list of vectors. Clicking on it again, deselcts and clear i

Go back to the `Overview` screen and you'll see R code again. It should look like this.

```
census_data <- get_census(dataset = "CA16", regions = list(CSD = "3530013"), vectors = c("v_CA16_4"),
    labels = "detailed", geo_format = NA, level = "DA")
```

Notice that this is exactly the same code as above; the only difference is that the `vectors` argument actually has something in it; namely `v_CA16_`, which is the total age vector.

I'm going to modify the code a little bit. We'll call the new dataframe `kitchener` again and remember you have to specify which geographical file format you want.

```
kitchener <- get_census(dataset = "CA16", regions = list(CSD = "3530013"), vectors = c("v_CA16_4"),
    labels = "detailed", geo_format = "sf", level = "DA")
```

```
## Downloading: 4.5 kB     Downloading: 4.5 kB     Downloading: 4.5 kB     Downloading: 4.5 kB     Downl
```

Now we glimpse the data again to take a look.

```
glimpse(kitchener)
```

```
## Observations: 314
## Variables: 14
## $ `Shape Area`              <dbl> 0.78200, 0.33188, 0.56447, 0.18680, 0.162...
## $ Type                      <fct> DA, DA, DA, DA, DA, DA, DA, DA, DA, DA, D...
## $ Dwellings                 <int> 230, 191, 254, 210, 199, 223, 306, 283, 1...
## $ Households                <int> 223, 168, 244, 210, 194, 217, 284, 268, 1...
## $ GeoUID                    <chr> "35300097", "35300098", "35300099", "3530...
## $ Population                <int> 588, 402, 552, 491, 425, 513, 584, 532, 4...
## $ CD_UID                    <chr> "3530", "3530", "3530", "3530", "3530", "...
## $ CSD_UID                   <chr> "3530013", "3530013", "3530013", "3530013...
## $ CT_UID                    <chr> "5410024.00", "5410024.00", "5410023.00",...
## $ CMA_UID                   <chr> "35541", "35541", "35541", "35541", "3554...
## $ geometry                  <MULTIPOLYGON [°]> MULTIPOLYGON (((-80.49342 4....
## $ `Region Name`             <fct> Kitchener, Kitchener, Kitchener, Kitchene...
## $ `Area (sq km)`            <dbl> 0.78200, 0.33188, 0.56447, 0.18680, 0.162...
## $ `v_CA16_4: 0 to 14 years` <dbl> 90, 60, 70, 70, 55, 90, 60, 65, 75, 25, 3...
```

Now, we have something that looks like the same dataset, but it has 14, rather than 11 variables. And the 14th variable `v_CA16_4: 0 to 14 years` is the one that we really want. It's a `dbl` variable, which is a fancy, overly complicated way of saying that it's a number tnat can have decimal numbers.

Now we could map out where the toddlers in Kitchener live. But before we do that, we might want to rename that ugly variable name.

We have practiced using the `rename()` command.

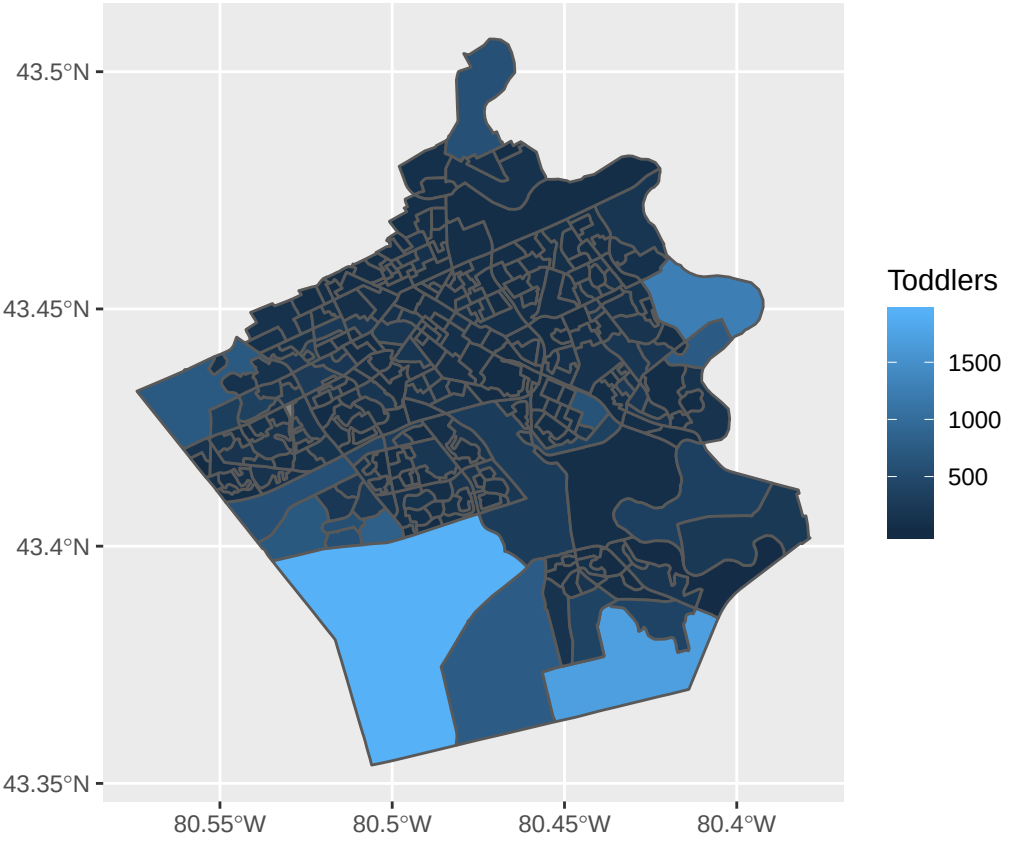
```
# Check the names
names(kitchener)
```

[1] “Shape Area” “Type”
[3] “Dwellings” “Households”
[5] “GeoUID” “Population”
[7] “CD_UID” “CSD_UID”
[9] “CT_UID” “CMA_UID”
[11] “geometry” “Region Name”
[13] “Area (sq km)” “v_CA16_4: 0 to 14 years”

```
# Do the rename(), remember to save into kitchener
kitchener <- rename(kitchener, Toddlers = `v_CA16_4: 0 to 14 years`)
# Check again.
names(kitchener)
```

[1] “Shape Area” “Type” “Dwellings” “Households” “GeoUID”
[6] “Population” “CD_UID” “CSD_UID” “CT_UID” “CMA_UID”
[11] “geometry” “Region Name” “Area (sq km)” “Toddlers”

```
ggplot(kitchener, aes(geometry = geometry, fill = Toddlers)) + geom_sf()
```



Now, note that these are *raw* numbers.

How do we add in a third variable.

Let’s just say that we want to break out the toddlers by sex. How would we do that, well we would have to go back to th

Some things to keep in mind

It's important to remember: Statistics Canada is not providing us with the individual level data from the census. They are aggregating it for us. What this means is that we cannot do a lot of crosstabulations by different variables.

For example, we could not show the distribution of toddlers of different ethnicities, for example unless Statistics Canada provides us with a table that has those two variables already combined.

The only variable that is almost always crosstabbed is sex. So we can always go back to the 0 to 4 years category and select the female and the male vectors.

The R code looks like this:

```
kitchener <- get_census(dataset = "CA16", regions = list(CSD = "3530013"), vectors = c("v_CA16_9",
    "v_CA16_8"), labels = "detailed", geo_format = "sf", level = "DA")
```

Note, how we're getting two new vectors.

```
glimpse(kitchener)
```

Observations: 314 Variables: 15 $ `Shape Area` 0.78200, 0.33188, 0.56447, 0.18680, 0.1620... $ Type DA, DA, DA, DA, DA, DA, DA, DA, DA, DA... $ Dwellings 230, 191, 254, 210, 199, 223, 306, 283, 18... $ Households 223, 168, 244, 210, 194, 217, 284, 268, 18... $ GeoUID "35300097", "35300098", "35300099", "35300... $ Population 588, 402, 552, 491, 425, 513, 584, 532, 45... $ CD_UID "3530","3530","3530","3530","3530","3... $ CSD_UID "3530013", "3530013", "3530013", "3530013"... $ CT_UID "5410024.00", "5410024.00", "5410023.00", ... $ CMA_UID "35541", "35541", "35541", "35541", "35541... $ geometry <MULTIPOLYGON [°]> MULTIPOLYGON (((-80.49342 4..... $ `Region Name` Kitchener, Kitchener, Kitchener, Kitchener... $ `Area (sq km)` 0.78200, 0.33188, 0.56447, 0.18680, 0.1620... $ `v_CA16_9: 0 to 4 years` 10, 10, 20, 10, 10, 10, 15, 20, 15, 10, 5,... $ `v_CA16_8: 0 to 4 years` 15, 10, 10, 15, 15, 15, 10, 15, 10, 10, 10... Those variable names are ugly so we should rename them again. If we go back to the website, we know that vector `v_CA16_9` is females and vector `v_CA16_8` is males.

And remember, we can use the `rename` command based on position as well as by name.

```
names(kitchener)
```

```
##  [1] "Shape Area"             "Type"                   "Dwellings"
##  [4] "Households"             "GeoUID"                 "Population"
##  [7] "CD_UID"                 "CSD_UID"                "CT_UID"
## [10] "CMA_UID"                "geometry"               "Region Name"
## [13] "Area (sq km)"           "v_CA16_9: 0 to 4 years" "v_CA16_8: 0 to 4 years"
```

```
kitchener <- rename(kitchener, Females = 14, Males = 15)
names(kitchener)
```

```
##  [1] "Shape Area"   "Type"         "Dwellings"    "Households"   "GeoUID"
##  [6] "Population"   "CD_UID"       "CSD_UID"      "CT_UID"       "CMA_UID"
## [11] "geometry"     "Region Name"  "Area (sq km)" "Females"      "Males"
```

Now the othe problem is that this is not tidy data. There are two different y-variables (`Females` and `Males`.)

Using the `gather()` command, we say what is the new `key` variable going to be called (i.e. `Sex`, the new value variable `n` and which variables get gathered).

```
kitchener <- gather(kitchener, Sex, n, Females, Males)

# you can do it with pipes.
kitchener <- kithener %>% gather(Sex, n, Females, Males)
```

```
glimpse(kitchener)
```

```
## Observations: 628
## Variables: 15
## $ `Shape Area`   <dbl> 0.78200, 0.33188, 0.56447, 0.18680, 0.16206, 0.15935...
## $ Type           <fct> DA, DA, DA, DA, DA, DA, DA, DA, DA, DA, DA, DA, DA, ...
## $ Dwellings      <int> 230, 191, 254, 210, 199, 223, 306, 283, 185, 360, 22...
## $ Households     <int> 223, 168, 244, 210, 194, 217, 284, 268, 185, 357, 21...
## $ GeoUID         <chr> "35300097", "35300098", "35300099", "35300100", "353...
## $ Population     <int> 588, 402, 552, 491, 425, 513, 584, 532, 459, 530, 37...
## $ CD_UID         <chr> "3530", "3530", "3530", "3530", "3530", "3530", "353...
## $ CSD_UID        <chr> "3530013", "3530013", "3530013", "3530013", "3530013...
## $ CT_UID         <chr> "5410024.00", "5410024.00", "5410023.00", "5410023.0...
## $ CMA_UID        <chr> "35541", "35541", "35541", "35541", "35541", "35541"...
## $ geometry       <MULTIPOLYGON [°]> MULTIPOLYGON (((-80.49342 4..., MULTIPO...
## $ `Region Name`  <fct> Kitchener, Kitchener, Kitchener, Kitchener, Kitchene...
## $ `Area (sq km)` <dbl> 0.78200, 0.33188, 0.56447, 0.18680, 0.16206, 0.15935...
## $ Sex            <chr> "Females", "Females", "Females", "Females", "Females...
## $ n              <dbl> 10, 10, 20, 10, 10, 10, 15, 20, 15, 10, 5, 5, 10, 15...
```

Now we could draw the map and facet on sex. Note now we have named the variable that has the actual number of toddlers to be `n`.

```
ggplot(kitchener, aes(geometry = geometry, fill = n)) + facet_wrap(~Sex)
```

You will find more of these crosstabs in the 25% data.

For example, if we go back to the variable selection screen.