TUTORIAL 6 | COMPARING CENSUS VARIABLES

Goals

- Become familiar with ACS data.
- Learn how to derive an average from census data.
- Consider the strengths and weaknesses of census data.
- Compare two different census categories geographically.
- Analyze demographic patterns through maps.

Introduction

In this tutorial, we'll be looking at a different kind of census data collected by a survey called the ACS (American Community Survey). After the 2000 census, the ACS began to replace the long-form decennial census. Now, every 10 years we answer only the short-form census; to supplement that data the ACS polls about 1% of the US population each year (around 3 million people). The ACS asks questions especially interesting to architects, such as age and type of housing, rental costs, occupants per room, mortgage costs, HVAC characteristics, and even building material. You can see the information ACS collects here:
https://www.census.gov/programs-surveys/acs/guidance/handbooks/general.html

Table excerpt from Chapter 1 below:

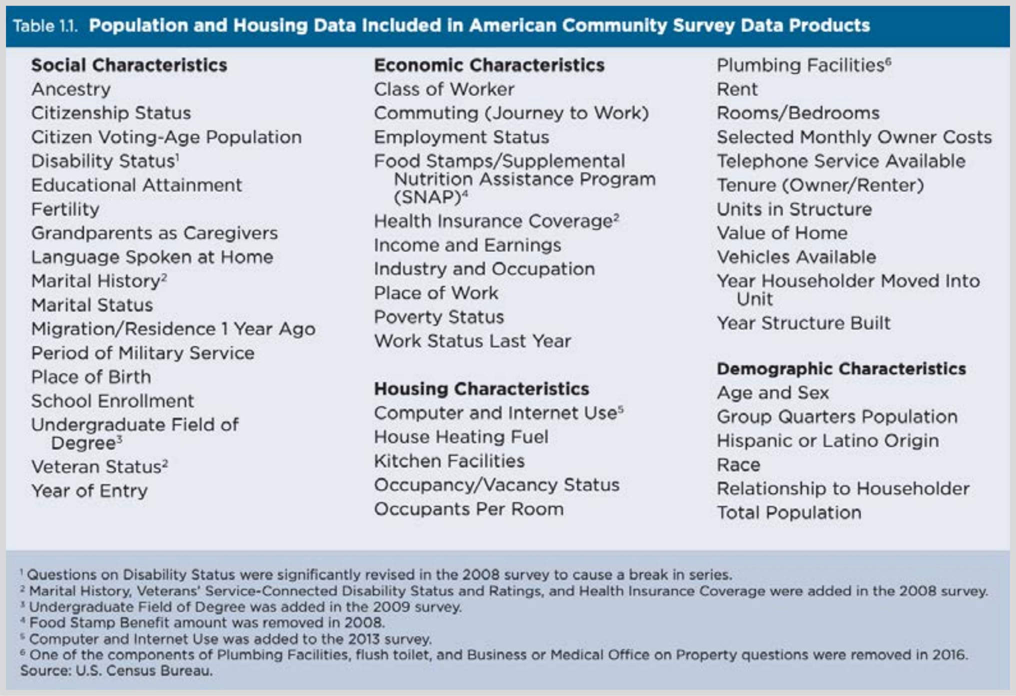


Table 1.1. **Population and Housing Data Included in American Community Survey Data Products**

Social Characteristics
Ancestry
Citizenship Status
Citizen Voting-Age Population
Disability Status[1]
Educational Attainment
Fertility
Grandparents as Caregivers
Language Spoken at Home
Marital History[2]
Marital Status
Migration/Residence 1 Year Ago
Period of Military Service
Place of Birth
School Enrollment
Undergraduate Field of Degree[3]
Veteran Status[2]
Year of Entry

Economic Characteristics
Class of Worker
Commuting (Journey to Work)
Employment Status
Food Stamps/Supplemental Nutrition Assistance Program (SNAP)[4]
Health Insurance Coverage[2]
Income and Earnings
Industry and Occupation
Place of Work
Poverty Status
Work Status Last Year

Housing Characteristics
Computer and Internet Use[5]
House Heating Fuel
Kitchen Facilities
Occupancy/Vacancy Status
Occupants Per Room
Plumbing Facilities[6]
Rent
Rooms/Bedrooms
Selected Monthly Owner Costs
Telephone Service Available
Tenure (Owner/Renter)
Units in Structure
Value of Home
Vehicles Available
Year Householder Moved Into Unit
Year Structure Built

Demographic Characteristics
Age and Sex
Group Quarters Population
Hispanic or Latino Origin
Race
Relationship to Householder
Total Population

[1] Questions on Disability Status were significantly revised in the 2008 survey to cause a break in series.
[2] Marital History, Veterans' Service-Connected Disability Status and Ratings, and Health Insurance Coverage were added in the 2008 survey.
[3] Undergraduate Field of Degree was added in the 2009 survey.
[4] Food Stamp Benefit amount was removed in 2008.
[5] Computer and Internet Use was added to the 2013 survey.
[6] One of the components of Plumbing Facilities, flush toilet, and Business or Medical Office on Property questions were removed in 2016.
Source: U.S. Census Bureau.

In this tutorial, we'll be looking at two variables: Home Occupancy Status (B25003), which specifies "renter" or "owner", and Median Household Income (B19013) over the last 12 months.

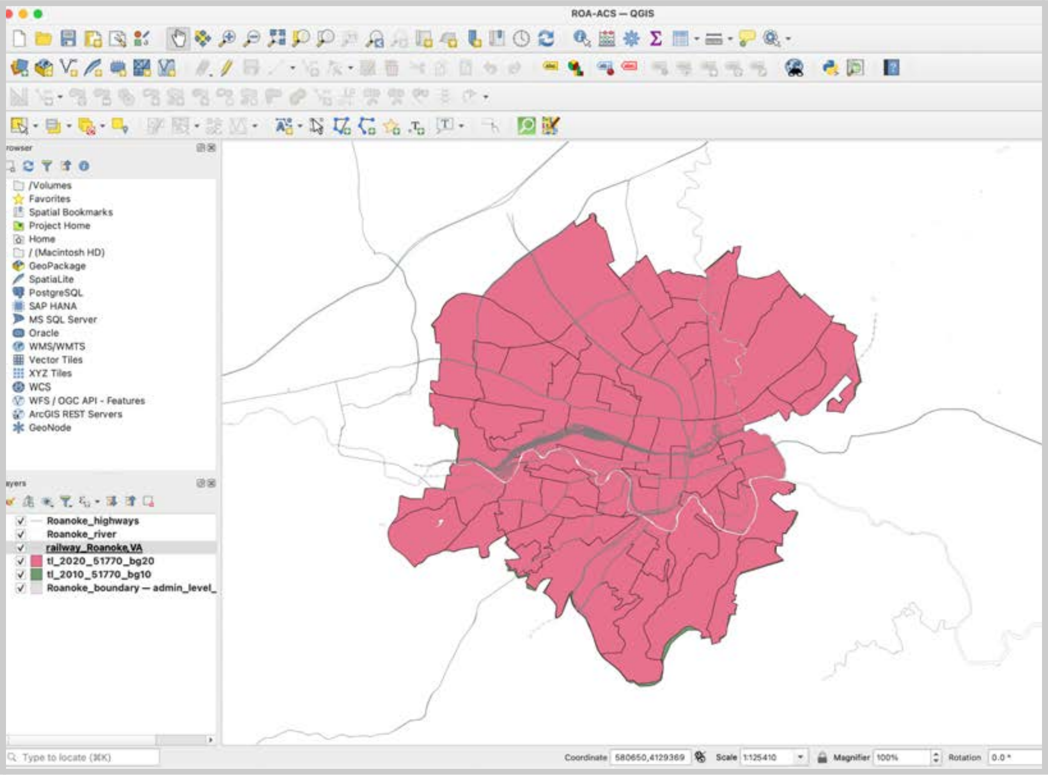
ACS data are aggregated to adjust for their small sample size. They come in 1-year, 3-year, and 5-year estimates. For these tutorials, we'll be using the 5-year estimates, which combine five adjacent ACS surveys. For example, the 5-year estimate for 2019 uses data collected from 2015-2019 – and not only 2019. These range estimates make ACS fundamentally different from decennial data which represents a single snapshot in time. Keep this in mind when interpreting and labeling the data.

Step 1: Open a new file and import TIGER/Line shapefiles and physical geography layers.

1a Set your CRS to 17N.

1b Import your city Block Group TIGER/Line Shapefiles for 2010 and 2020.

1c Add a few physical geography layers for reference. I recommend adding the railroad lines and major roads / highways, as well as the river.



Step 2: Associate new ACS data with the TIGER shapefiles.

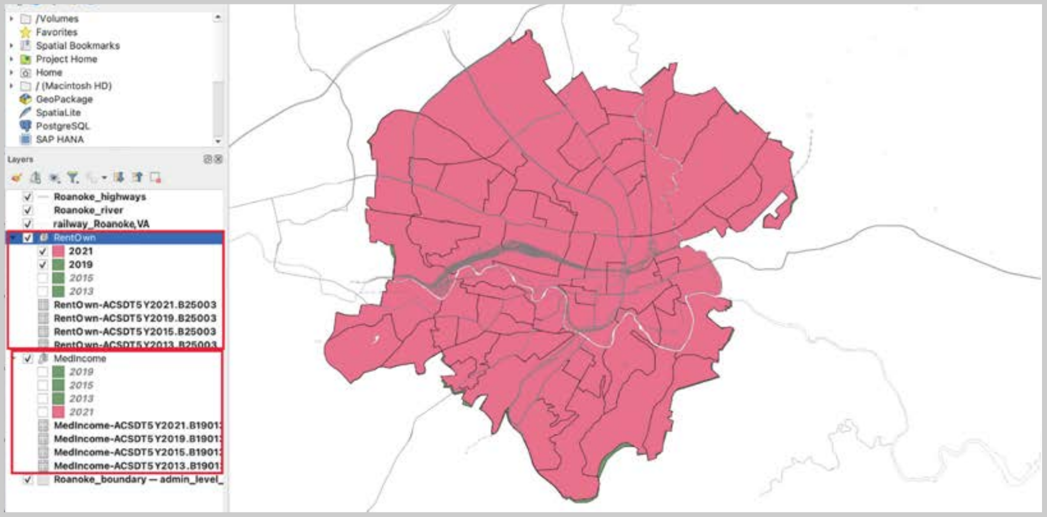
You'll see that you have 4 ACS datasets for each variable: the 5-year estimates for 2013 (the earliest year available), 2015, 2019, and 2021 (the most recent available). This range will allow you to see patterns over time, though keep in mind that each estimate includes the previous 4 years as well. So, the 2013 dataset includes information collected between 2009-2013; the 2021 includes 2017-2021; etc.

The **2013, 2015, and 2019** estimates will all join to the **2010 shapefile**. Any estimate between 2010-2019 will use the 2010 shapefile. Estimates beginning in 2020 use the 2020 shapefile, so the 2021 data will join with the 2020 shapefile. You'll make a separate copy of your shapefile layer for each dataset joined, rather than joining multiple datasets to one shapefile. This will make it easier to turn the different years on and off.

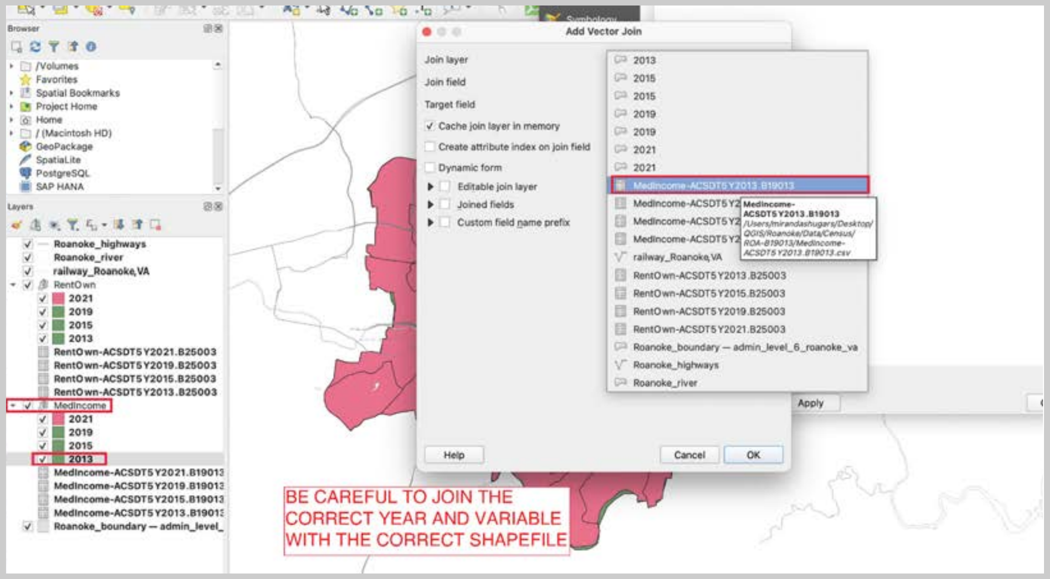
2a Import the **4 data tables each** for B25003 (Rent vs. Own) and B19013 (Median Income) (**8 csv files total**).

2b Create 5 copies (right click > **duplicate layer**) of your 2010 block group shapefile and 1 copy of your 2020, so that you have **8 shapefile layers** total to match your 8 data tables – 6 from 2010, and 2 from 2020. **Group** half the shapefiles with one ACS variable and half with the other. You should end up with **one group for Median Income** (4 data tables and 4 shapefiles) and **one group for Homeownership Status** (4 data tables and 4 shapefiles).

Now, **re-name your shapefile layers** within each group to match the year of the data table you'll join with it (eg, "2013", "2021"). This will help you keep track of the joins.


/Volumes
Favorites
Spatial Bookmarks
Project Home
Home
/ (Macintosh HD)
GeoPackage
SpatiaLite
PostgreSQL
SAP HANA
Layers
Roanoke_highways
Roanoke_river
railway_Roanoke,VA
RentOwn
2021
2019
2015
2013
RentOwn-ACSDT5Y2021.B25003
RentOwn-ACSDT5Y2019.B25003
RentOwn-ACSDT5Y2015.B25003
RentOwn-ACSDT5Y2013.B25003
MedIncome
2019
2015
2013
2021
MedIncome-ACSDT5Y2021.B1901
MedIncome-ACSDT5Y2019.B1901
MedIncome-ACSDT5Y2015.B1901
MedIncome-ACSDT5Y2013.B1901
Roanoke_boundary — admin_level_

2c Join your .csv layer with your shapefiles (**double click > Join; GEOID to GEOID**). Make sure to match each year to the appropriate layer. Make sure to check that the join worked by looking at each layer's Attribute Table afterwards and making sure you don't see a column of "Null" values. Make sure to join the 2021 data tables to the 2020 shapefiles, and all others to the 2010 shapefiles.


Browser
/Volumes
Favorites
Spatial Bookmarks
Project Home
Home
/ (Macintosh HD)
GeoPackage
SpatiaLite
PostgreSQL
SAP HANA
Layers
Roanoke_highways
Roanoke_river
railway_Roanoke,VA
RentOwn
2021
2019
2015
2013
RentOwn-ACSDT5Y2021.B25003
RentOwn-ACSDT5Y2019.B25003
RentOwn-ACSDT5Y2015.B25003
RentOwn-ACSDT5Y2013.B25003
MedIncome
2021
2019
2015
2013
MedIncome-ACSDT5Y2021.B19013
MedIncome-ACSDT5Y2019.B19013
MedIncome-ACSDT5Y2015.B19013
MedIncome-ACSDT5Y2013.B19013
Roanoke_boundary — admin_level_
Apply

Add Vector Join

Join layer

Join field

Target field

☑ Cache join layer in memory

□ Create attribute index on join field

□ Dynamic form

▶ □ Editable join layer

▶ □ Joined fields

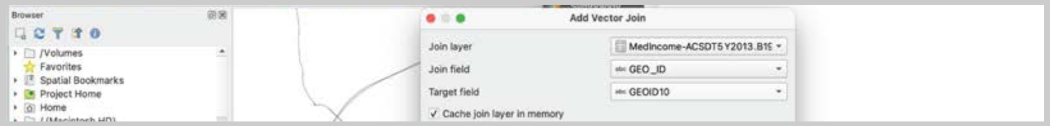
▶ □ Custom field name prefix

2013
2015
2015
2019
2019
2021
2021
MedIncome-ACSDT5Y2013.B19013
MedIncome-ACSDT5Y2
MedIncome-ACSDT5Y2
MedIncome-ACSDT5Y2
railway_Roanoke,VA
RentOwn-ACSDT5Y2013.B25003
RentOwn-ACSDT5Y2015.B25003
RentOwn-ACSDT5Y2019.B25003
RentOwn-ACSDT5Y2021.B25003
Roanoke_boundary — admin_level_6_roanoke_va
Roanoke_highways
Roanoke_river

MedIncome-ACSDT5Y2013.B19013
/Users/mirandashugars/Desktop/QGIS/Roanoke/Data/Census/ROA-B19013/MedIncome-ACSDT5Y2013.B19013.csv

Help Cancel OK

BE CAREFUL TO JOIN THE CORRECT YEAR AND VARIABLE WITH THE CORRECT SHAPEFILE



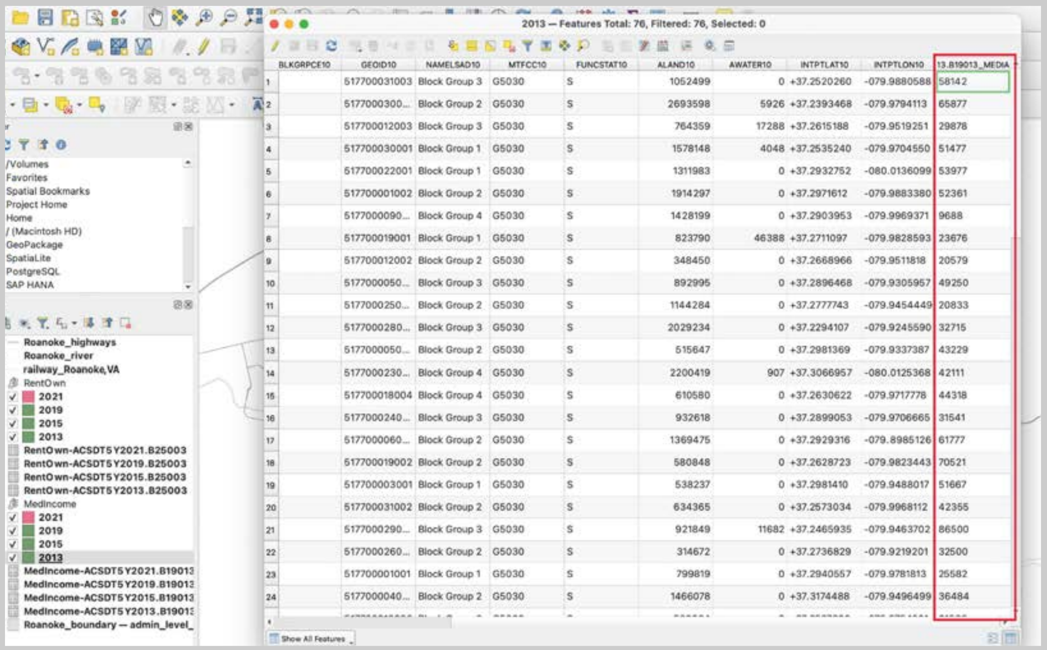
Add Vector Join

Join layer: MedIncome-ACSDT5Y2013.B19

Join field: GEO_ID

Target field: GEOID10

☑ Cache join layer in memory


/Volumes
Favorites
Spatial Bookmarks
Project Home
Home
/ (Macintosh HD)
GeoPackage
SpatiaLite
PostgreSQL
SAP HANA
Roanoke_highways
Roanoke_river
railway_Roanoke,VA
RentOwn
2021
2019
2015
2013
RentOwn-ACSDT5Y2021.B25003
RentOwn-ACSDT5Y2019.B25003
RentOwn-ACSDT5Y2015.B25003
RentOwn-ACSDT5Y2013.B25003
MedIncome
2021
2019
2015
2013
MedIncome-ACSDT5Y2021.B19013
MedIncome-ACSDT5Y2019.B19013
MedIncome-ACSDT5Y2015.B19013
MedIncome-ACSDT5Y2013.B19013
Roanoke_boundary — admin_level_
Show All Features

2013 — Features Total: 76, Filtered: 76, Selected: 0

	BLKGRPCE10	GEOID10	NAMELSAD10	MTFCC10	FUNCSTAT10	ALAND10	AWATER10	INTPTLAT10	INTPTLON10	13.B19013_MEDIA
1		517700031003	Block Group 3	G5030	S	1052499	0	+37.2520260	-079.9880588	58142
2		5177000300...	Block Group 2	G5030	S	2693598	5926	+37.2393468	-079.9794113	65877
3		517700012003	Block Group 3	G5030	S	764359	17288	+37.2615188	-079.9519251	29878
4		517700030001	Block Group 1	G5030	S	1578148	4048	+37.2535240	-079.9704550	51477
5		517700022001	Block Group 1	G5030	S	1311983	0	+37.2932752	-080.0136099	53977
6		517700001002	Block Group 2	G5030	S	1914297	0	+37.2971612	-079.9883380	52361
7		5177000090...	Block Group 4	G5030	S	1428199	0	+37.2903953	-079.9969371	9688
8		517700019001	Block Group 1	G5030	S	823790	46388	+37.2711097	-079.9828593	23676
9		517700012002	Block Group 2	G5030	S	348450	0	+37.2668966	-079.9511818	20579
10		5177000050...	Block Group 3	G5030	S	892995	0	+37.2896468	-079.9305957	49250
11		5177000250...	Block Group 2	G5030	S	1144284	0	+37.2777743	-079.9454449	20833
12		5177000280...	Block Group 3	G5030	S	2029234	0	+37.2294107	-079.9245590	32715
13		5177000050...	Block Group 2	G5030	S	515647	0	+37.2981369	-079.9337387	43229
14		5177000230...	Block Group 4	G5030	S	2200419	907	+37.3066957	-080.0125368	42111
15		517700018004	Block Group 4	G5030	S	610580	0	+37.2630622	-079.9717778	44318
16		5177000240...	Block Group 3	G5030	S	932618	0	+37.2899053	-079.9706665	31541
17		5177000060...	Block Group 2	G5030	S	1369475	0	+37.2929316	-079.8985126	61777
18		517700019002	Block Group 2	G5030	S	580848	0	+37.2628723	-079.9823443	70521
19		517700003001	Block Group 1	G5030	S	538237	0	+37.2981410	-079.9488017	51667
20		517700031002	Block Group 2	G5030	S	634365	0	+37.2573034	-079.9968112	42355
21		5177000290...	Block Group 3	G5030	S	921849	11682	+37.2465935	-079.9463702	86500
22		5177000260...	Block Group 2	G5030	S	314672	0	+37.2736829	-079.9219201	32500
23		517700001001	Block Group 1	G5030	S	799819	0	+37.2940557	-079.9781813	25582
24		5177000040...	Block Group 2	G5030	S	1466078	0	+37.3174488	-079.9496499	36484

Step 3: Style the data according to median income.

Like we did in the last tutorial, we need to style the two variables in this tutorial – median income and homeownership status – using a consistent style so we can compare between years. To take the example of median income, the range of median incomes varies between years. In 2013 in Roanoke, the median income for a given block group ranged from $6k - 147k, while in 2021 it ranged from $20k - $146k. That's a pretty large increase in the lowest median income. Keep in mind that these are median household incomes, not median individual incomes.

There are many things that might account for this increase. It could be that the census changed their estimation method, or that the lower-income areas grew in population and raised the number. Typically census block groups are organized roughly around population, so the population should be fairly consistent from one block group to the next. However, it's worth considering that a very high or very low income block group – especially one that varies considerably from the next closest median income – might have an especially low population that skews the data. You can easily see this by first checking your Attribute Tables and organizing them by median income to check for outliers (unusually high or low values). Second, you can check the population of each block group using the "Total" column in the *Homeownership Status* data.

3a To start off, let's find an appropriate range for the median income data. First, open each of your **four median income data table csvs** in Excel, Numbers, Google Sheets, or another spreadsheet software. Order each by its **median income column**, both **Ascending and Descending**. Make a note of the **highest and lowest values of each year** (2013, 2015, 2019, and 2021), and then take the overall lowest and overall highest number as your **min and max**. For Roanoke, I found a min of $6029 (round **down** to $6,000) and a max of $155208 (round **up** to $160,000) – so my range is 6k - 160k.

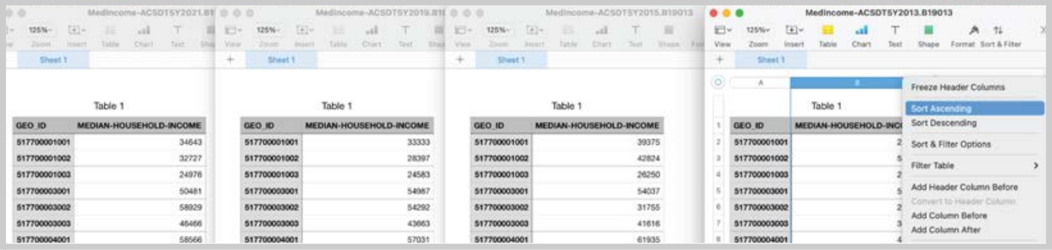


Table 1

GEO_ID	MEDIAN-HOUSEHOLD-INCOME
517700001001	34643
517700001002	32727
517700001003	24976
517700003001	50481
517700003002	58929
517700003003	46466
517700004001	58566

Table 1

GEO_ID	MEDIAN-HOUSEHOLD-INCOME
517700001001	33333
517700001002	28397
517700001003	24583
517700003001	54987
517700003002	54292
517700003003	43663
517700004001	57031

Table 1

GEO_ID	MEDIAN-HOUSEHOLD-INCOME
517700001001	39375
517700001002	42824
517700001003	26250
517700003001	54037
517700003002	31755
517700003003	41616
517700004001	61935

Table 1

	GEO_ID	MEDIAN-HOUSEHOLD-INC
1	GEO_ID	MEDIAN-HOUSEHOLD-INC
2	517700001001	2
3	517700001002	5
4	517700001003	2
5	517700003001	5
6	517700003002	2
7	517700003003	3
8	517700004001	4

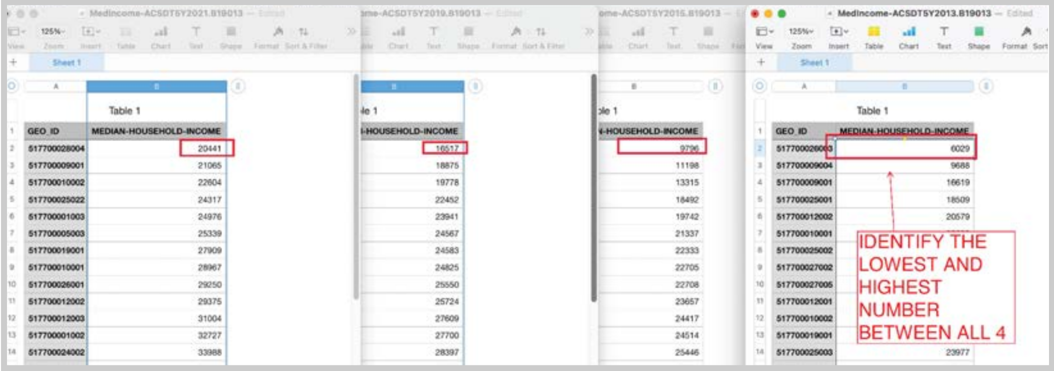

MedIncome-ACSDT5Y2021.B19013 — Edited
me-ACSDT5Y2019.B19013 — Edited
ome-ACSDT5Y2015.B19013
MedIncome-ACSDT5Y2013.B19013 — Edited
View
Zoom
Insert
Table
Chart
Text
Shape
Format
Sort & Filter
Sheet 1
A
B

Table 1

	GEO_ID	MEDIAN-HOUSEHOLD-INCOME
2	517700028004	20441
3	517700009001	21065
4	517700010002	22604
5	517700025022	24317
6	517700001003	24976
7	517700005003	25339
8	517700019001	27909
9	517700010001	28967
10	517700026001	29250
11	517700012002	29375
12	517700012003	31004
13	517700001002	32727
14	517700024002	33988

le 1

-HOUSEHOLD-INCOME
16517
18875
19778
22452
23941
24567
24583
24825
25550
25724
27609
27700
28397

le 1

N-HOUSEHOLD-INCOME
9796
11198
13315
18492
19742
21337
22333
22705
22708
23657
24417
24514
25446

Table 1

	GEO_ID	MEDIAN-HOUSEHOLD-INCOME
2	517700026003	6029
3	517700009004	9688
4	517700009001	16619
5	517700025001	18509
6	517700012002	20579
7	517700010001	
8	517700025002	
9	517700027002	
10	517700027005	
11	517700012001	
12	517700010002	
13	517700019001	
14	517700025003	23977

IDENTIFY THE LOWEST AND HIGHEST NUMBER BETWEEN ALL 4

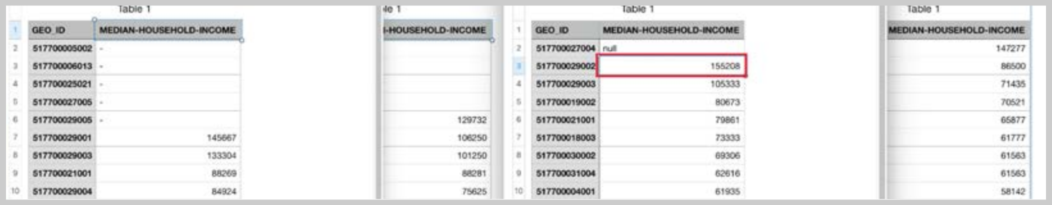


Table 1

	GEO_ID	MEDIAN-HOUSEHOLD-INCOME
2	517700005002	-
3	517700006013	-
4	517700025021	-
5	517700027005	-
6	517700029005	-
7	517700029001	145667
8	517700029003	133304
9	517700021001	88269
10	517700029004	84924

le 1

-HOUSEHOLD-INCOME
129732
106250
101250
88281
75625

Table 1

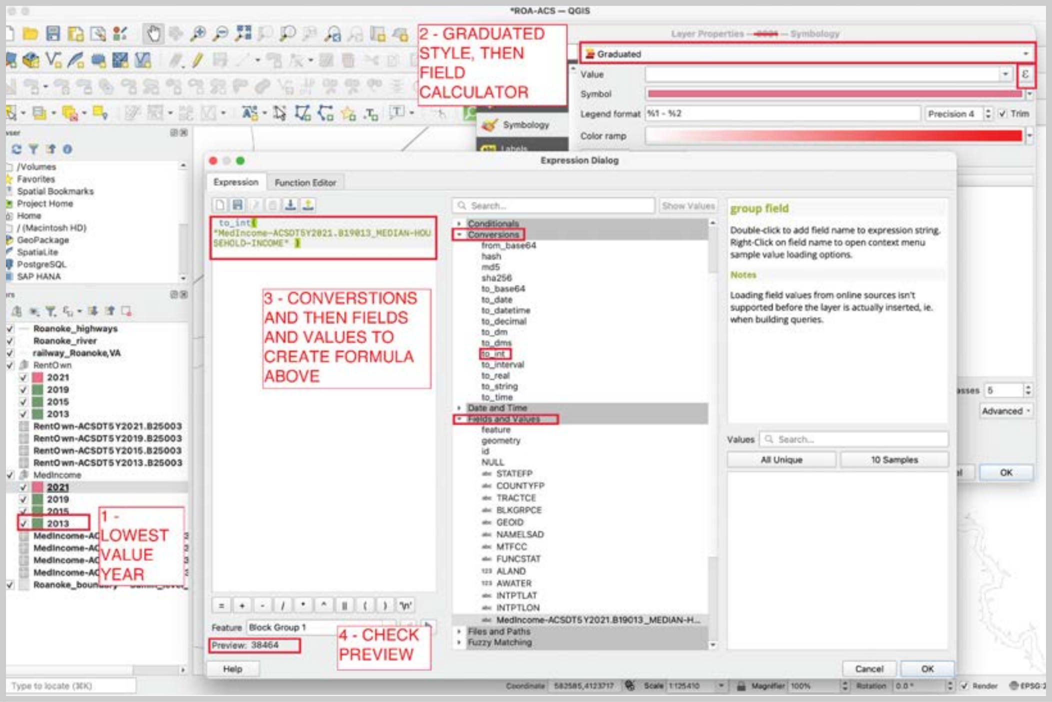
	GEO_ID	MEDIAN-HOUSEHOLD-INCOME
2	517700027004	null
3	517700029002	155208
4	517700029003	105333
5	517700019002	80673
6	517700021001	79861
7	517700018003	73333
8	517700030002	69306
9	517700031004	62616
10	517700004001	61935

Table 1

MEDIAN-HOUSEHOLD-INCOME
147277
86500
71435
70521
65877
61777
61563
61563
58142

3b Next, open the **Symbology** in your Layer Properties for the median income shapefile with the **lowest minimum**. Select “**Graduated**”, and then open your **field calculator** for Value. Expand your “**Fields and Values**” and find the Median Income variable. Notice that beside the variable is a small “**abc**”, rather than a “123”. This means that the variable is a “string”, or text-based, rather than an “integer”, or number-based.

You’ll need to convert the variable to an integer before you can use it with the graduated style. To do this, expand the “**Conversions**” section of the field calculator and double click on “**to_int**” near the bottom. This will insert a “to_int (“ to your field calculator. Now, add in the **Median Income** field (double click it under Fields and Values), and the closing parentheses – it should be **to_int (“MedianIncome”)**


1 - LOWEST VALUE YEAR

2 - GRADUATED STYLE, THEN FIELD CALCULATOR

3 - CONVERSTIONS AND THEN FIELDS AND VALUES TO CREATE FORMULA ABOVE

4 - CHECK PREVIEW

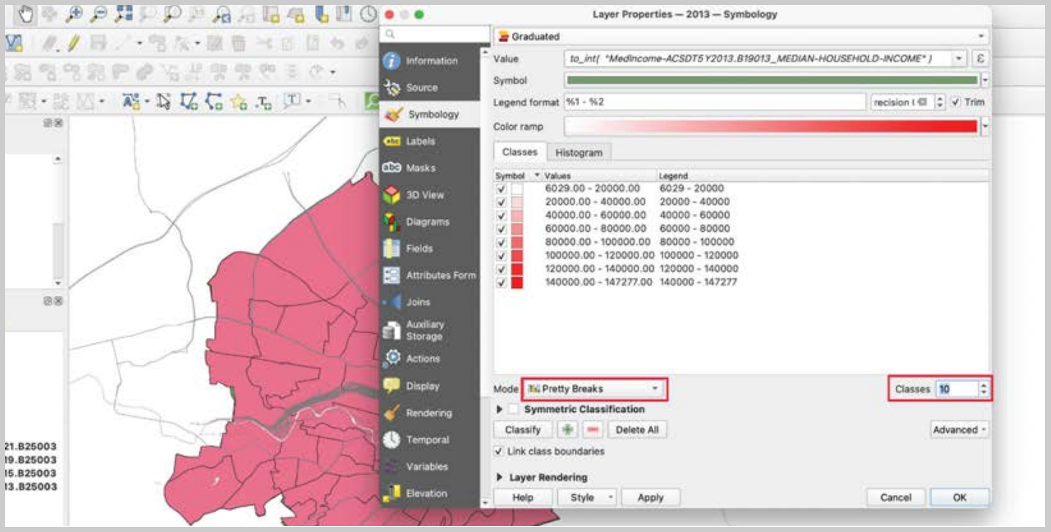
```
to_int(
"MedIncome-ACSDT5Y2021.B19013_MEDIAN-HOUSEHOLD-INCOME" )
```

Feature: Block Group 1

Preview: 38464

As always, check that the “**Preview**” looks alright, and then click “Ok”.

3c This time we’re going to use the classification **mode** “**Pretty Breaks**” to set up our intervals. First set your classes to 10, and then select “Pretty Breaks”. You’ll see that it produces pleasingly even numbers. After this, **manually set** your **minimum** value to the lowest median income you found across *all four data sets,* and your **maximum** value to the highest you found.



Layer Properties — 2013 — Symbology

Graduated

Value: to_int("MedIncome-ACSDT5Y2013.B19013_MEDIAN-HOUSEHOLD-INCOME")

Legend format: %1 - %2

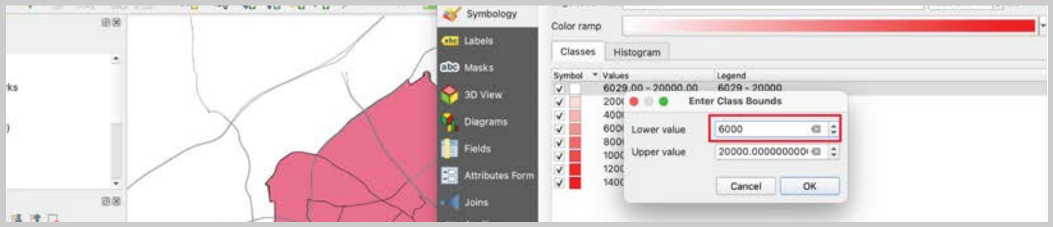
☑ Trim

Symbol	Values	Legend
☑	6029.00 - 20000.00	6029 - 20000
☑	20000.00 - 40000.00	20000 - 40000
☑	40000.00 - 60000.00	40000 - 60000
☑	60000.00 - 80000.00	60000 - 80000
☑	80000.00 - 100000.00	80000 - 100000
☑	100000.00 - 120000.00	100000 - 120000
☑	120000.00 - 140000.00	120000 - 140000
☑	140000.00 - 147277.00	140000 - 147277

Mode: Pretty Breaks

Classes: 10

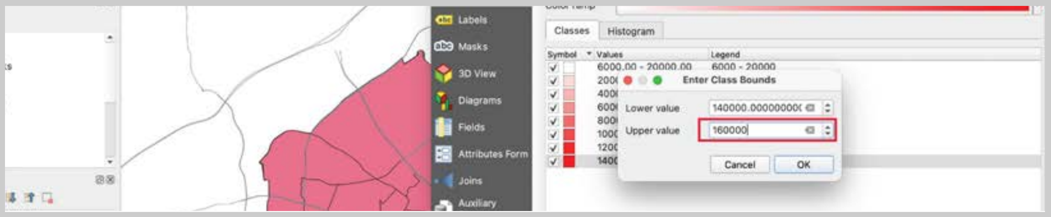
☑ Link class boundaries



Enter Class Bounds

Lower value: 6000

Upper value: 20000.000000000



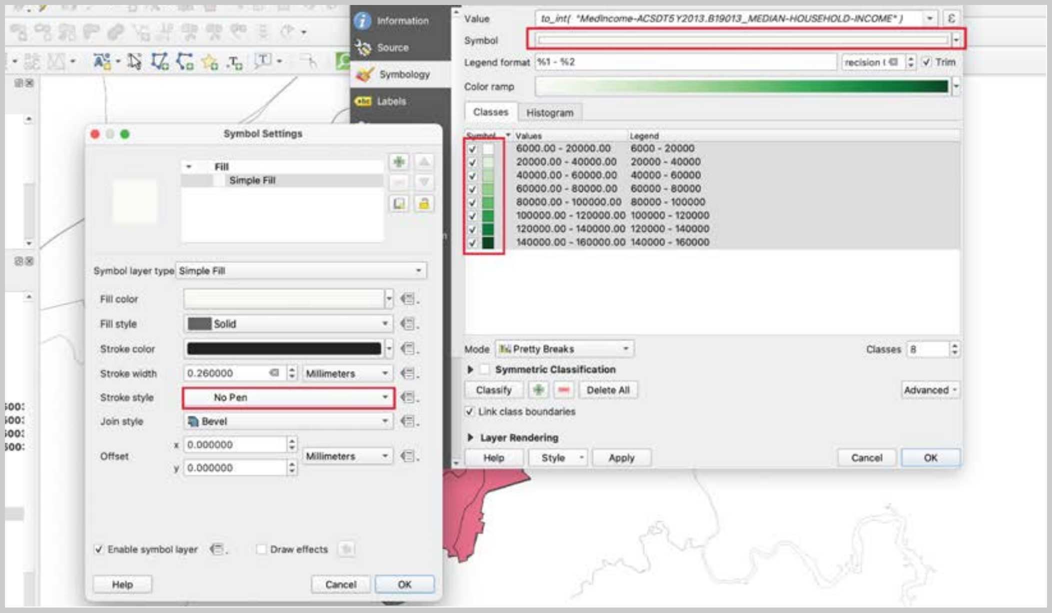
Enter Class Bounds

Lower value: 140000.00000000

Upper value: 160000

Select all classes and set your boundary style to **“No Pen”**, and then **Save your Style**.

NOTE: Make sure that each variable has its own color gradient. Use a different gradient for race vs. income vs. ownership status. This is a cardinal rule of mapping: **use a different color for each variable**.



Symbol Settings

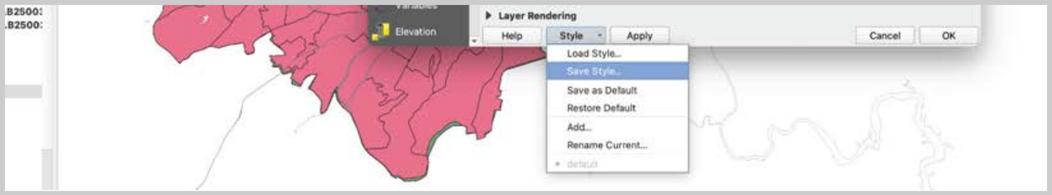
Fill
Simple Fill

Symbol layer type: Simple Fill
Fill color:
Fill style: Solid
Stroke color:
Stroke width: 0.260000 Millimeters
Stroke style: No Pen
Join style: Bevel
Offset: x 0.000000, y 0.000000 Millimeters
☑ Enable symbol layer ☐ Draw effects

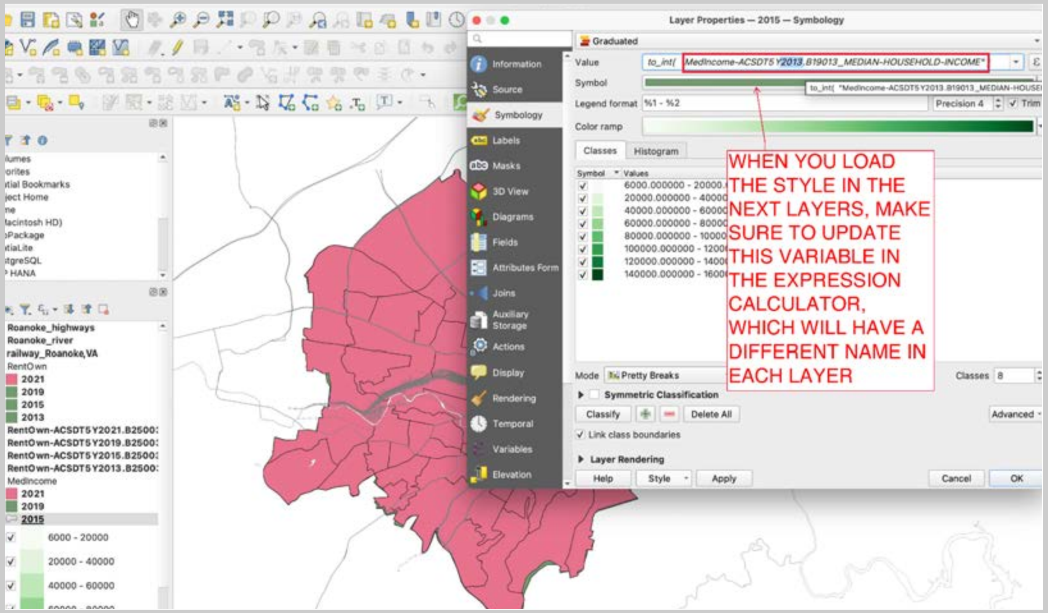
Value: to_int("MedIncome-ACSDT5Y2013.B19013_MEDIAN-HOUSEHOLD-INCOME")
Symbol:
Legend format: %1 - %2 recision ☑ Trim
Color ramp:

Symbol	Values	Legend
✓	6000.00 - 20000.00	6000 - 20000
✓	20000.00 - 40000.00	20000 - 40000
✓	40000.00 - 60000.00	40000 - 60000
✓	60000.00 - 80000.00	60000 - 80000
✓	80000.00 - 100000.00	80000 - 100000
✓	100000.00 - 120000.00	100000 - 120000
✓	120000.00 - 140000.00	120000 - 140000
✓	140000.00 - 160000.00	140000 - 160000

Mode: Pretty Breaks Classes: 8
☐ Symmetric Classification
☑ Link class boundaries



3d Apply the style to your other three median income layers (**Load Style**). Note that you will need to **change the field name in the expression calculator** to match each data table's differently named variables. Usually this will only require changing the year (eg from "2013" to "2015") in the variable equation.



Layer Properties — 2015 — Symbology

Graduated
Value: to_int("MedIncome-ACSDT5Y2013.B19013_MEDIAN-HOUSEHOLD-INCOME"
Legend format: %1 - %2 Precision 4 ☑ Trim

Symbol	Values
✓	6000.000000 - 20000.(
✓	20000.000000 - 40000
✓	40000.000000 - 6000(
✓	60000.000000 - 8000(
✓	80000.000000 - 10000
✓	100000.000000 - 1200(
✓	120000.000000 - 1400(
✓	140000.000000 - 1600(

Mode: Pretty Breaks Classes: 8
☐ Symmetric Classification
☑ Link class boundaries

WHEN YOU LOAD THE STYLE IN THE NEXT LAYERS, MAKE SURE TO UPDATE THIS VARIABLE IN THE EXPRESSION CALCULATOR, WHICH WILL HAVE A DIFFERENT NAME IN EACH LAYER

Step 4: Join and style your second ACS variable, Homeownership Status.

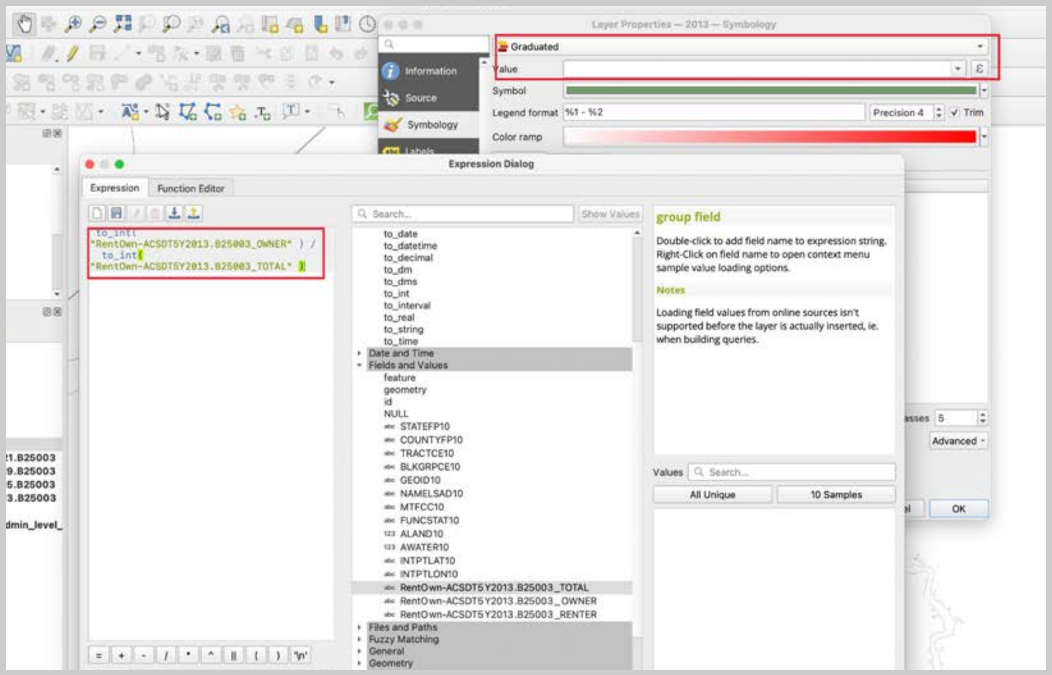
4a Join your B1903 Homeownership data tables with their corresponding shapefiles, as you did for median income. Check the shapefile Attribute Tables to make sure they joined correctly.

4b You should now have two layer groups: one for Median Income and one for Homeownership Status, each with four joined shapefile layers: 2013, 2015, 2019, and 2021.

Now, open up one of your Homeownership shapefiles and set the Symbology to “**Graduated**”. As with Median Income, you’ll need to use the field calculator for this one. Open it up and check your “**Fields and Values”**. Notice that, again, the Homeownership fields (Total, Owner, and Renter) are “abc” text fields rather than integer fields. This is a common issue with ACS data. Luckily, the solution is simple: we can use the to_int formula.

For the Homeownership data, like for the Race data in the previous tutorial, we want to look at percentages rather than raw numbers. This will help us adjust for population differences between the block groups. To get the **percentage** of home ownership, we’ll **divide the “Owner” variable by the “Total” variable**. You’ll need to convert them both to integers first (**Conversions > to_int**). So, your formula will look like: to_int (“Owner”) / to_int (“Total”), where “Owner” and “Total” are the names of your specific fields.

Before clicking OK, check that the “**Preview**” looks alright.



```
 to_int(
"RentOwn-ACSDT5Y2013.B25003_OWNER" ) /
  to_int(
"RentOwn-ACSDT5Y2013.B25003_TOTAL" )
```

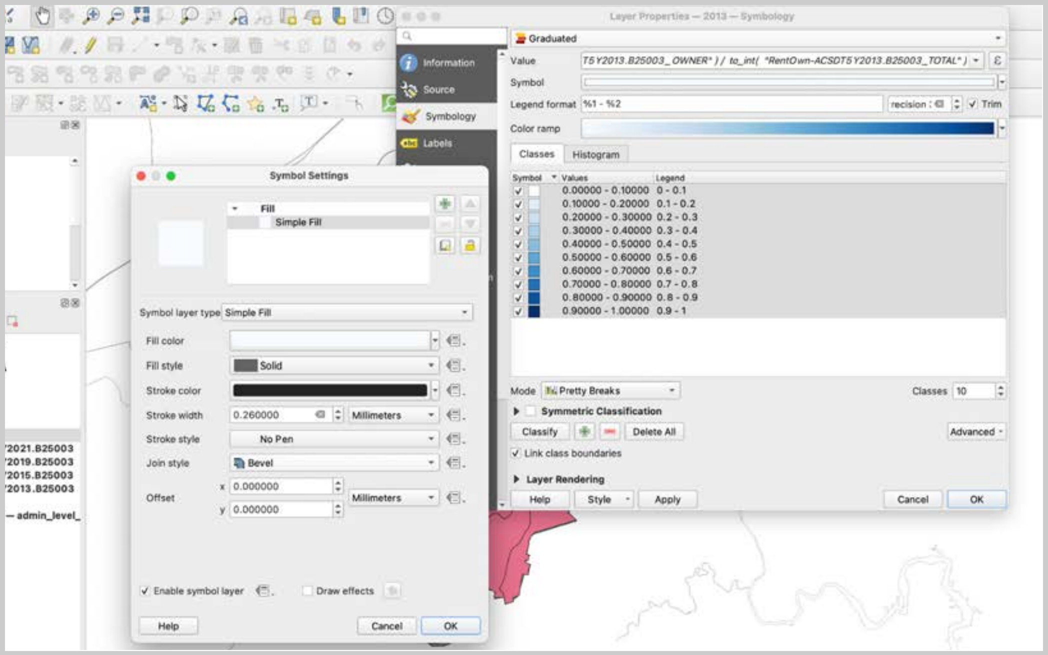
group field

Double-click to add field name to expression string. Right-Click on field name to open context menu sample value loading options.

Notes

Loading field values from online sources isn't supported before the layer is actually inserted, ie. when building queries.

4c Set your classes to “**10**”, and select “**Pretty Breaks**” again. This may get you even 10 percentage point breaks (0-0.1, 0.1-0.2, etc.), but you may need to **manually** edit some of the values. In my case, the lowest number was 0.04 instead of 0, so I manually changed that value to 0. Make sure you have 10 classes, each with a 0.1 interval, from 0 to 1 (0% to 100%).



Layer Properties — 2013 — Symbology

Graduated

Value: T5Y2013.B25003_OWNER") / to_int("RentOwn-ACSDT5Y2013.B25003_TOTAL")

Legend format: %1 - %2 ☑ Trim

Symbol	Values	Legend
☑	0.00000 - 0.10000	0 - 0.1
☑	0.10000 - 0.20000	0.1 - 0.2
☑	0.20000 - 0.30000	0.2 - 0.3
☑	0.30000 - 0.40000	0.3 - 0.4
☑	0.40000 - 0.50000	0.4 - 0.5
☑	0.50000 - 0.60000	0.5 - 0.6
☑	0.60000 - 0.70000	0.6 - 0.7
☑	0.70000 - 0.80000	0.7 - 0.8
☑	0.80000 - 0.90000	0.8 - 0.9
☑	0.90000 - 1.00000	0.9 - 1

Mode: Pretty Breaks Classes: 10

☑ Link class boundaries

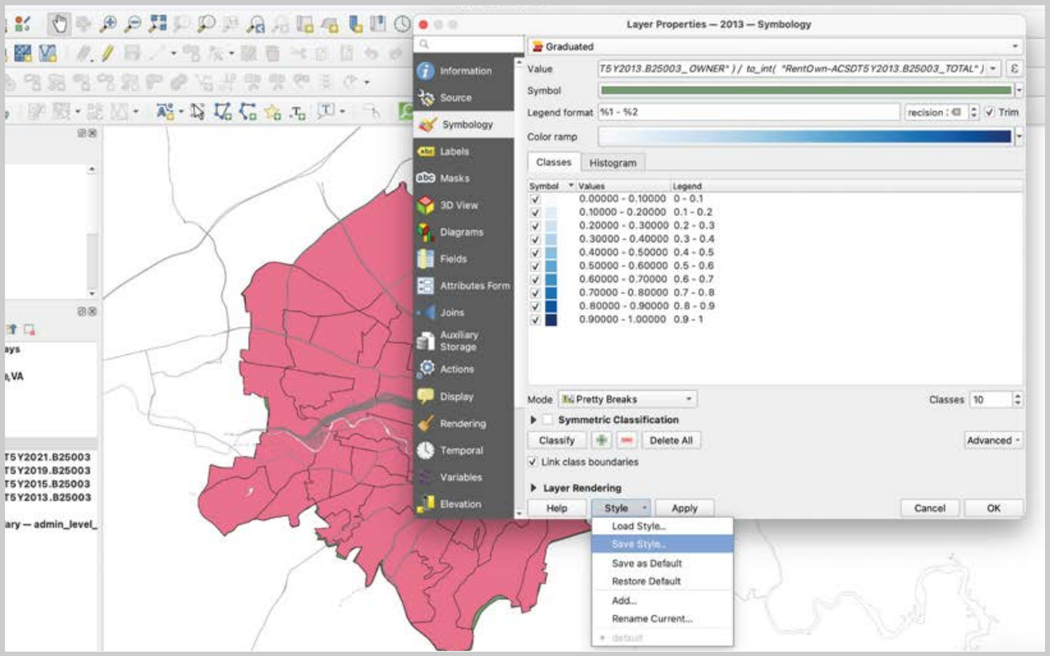
Symbol Settings

Fill
Simple Fill

Symbol layer type: Simple Fill
Fill style: Solid
Stroke width: 0.260000 Millimeters
Stroke style: No Pen
Join style: Bevel
Offset x: 0.000000 y: 0.000000 Millimeters

☑ Enable symbol layer □ Draw effects

4d Make sure to set your outline style to "**No Pen**" and choose a different color gradient than you used for Median Income. **Save your Style.**



Layer Properties — 2013 — Symbology

Graduated

Value: T5Y2013.B25003_OWNER") / to_int("RentOwn-ACSDT5Y2013.B25003_TOTAL")

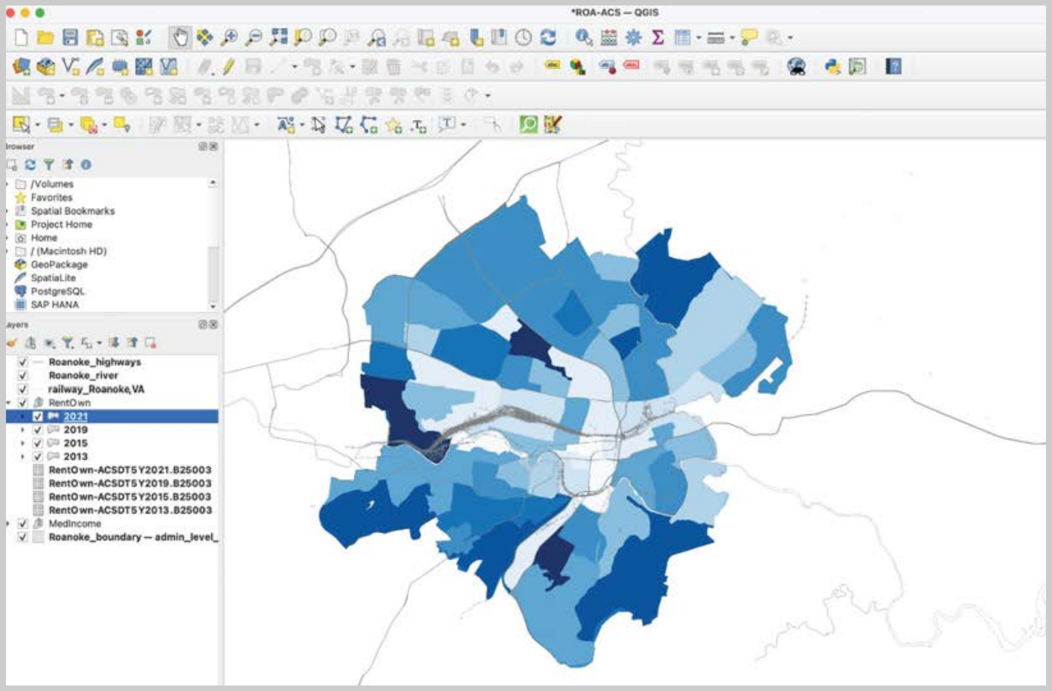
Legend format: %1 - %2 ☑ Trim

Symbol	Values	Legend
☑	0.00000 - 0.10000	0 - 0.1
☑	0.10000 - 0.20000	0.1 - 0.2
☑	0.20000 - 0.30000	0.2 - 0.3
☑	0.30000 - 0.40000	0.3 - 0.4
☑	0.40000 - 0.50000	0.4 - 0.5
☑	0.50000 - 0.60000	0.5 - 0.6
☑	0.60000 - 0.70000	0.6 - 0.7
☑	0.70000 - 0.80000	0.7 - 0.8
☑	0.80000 - 0.90000	0.8 - 0.9
☑	0.90000 - 1.00000	0.9 - 1

Mode: Pretty Breaks Classes: 10

☑ Link class boundaries

4e **Load your Style** for each of your three remaining Homeownership layers, being sure to update the Fields in your expression calculator to match.


*ROA-ACS — QGIS
Browser
/Volumes
Favorites
Spatial Bookmarks
Project Home
Home
/ (Macintosh HD)
GeoPackage
SpatiaLite
PostgreSQL
SAP HANA
Layers
Roanoke_highways
Roanoke_river
railway_Roanoke,VA
RentOwn
2021
2019
2015
2013
RentOwn-ACSDT5Y2021.B25003
RentOwn-ACSDT5Y2019.B25003
RentOwn-ACSDT5Y2015.B25003
RentOwn-ACSDT5Y2013.B25003
MedIncome
Roanoke_boundary — admin_level_

Step 5: Create a Print Layout to compare the two data sets.

Flipping between the four data layers for each variable, you might see some slight trends upwards or downwards, but specific block groups (roughly, neighborhoods) might go up while the city goes down, or vice-versa. You may not see clear or explicit trends in this data.

However, if you start to compare between the two variables, you might notice more of a pattern. Unsurprisingly, lower median income corresponds with lower rates of home ownership. You can demonstrate this in your print layout by comparing your 8 maps, divided by year.

You might also notice one or two neighborhoods where the two variables do not correlate across all four years. Call one of these out in zoomed-in maps on a **second** print layout page. Using Google, identify the neighborhood and give a brief historical explanation of why median income and homeownership might not correlate.

Remember to add titles, subtitles, legends, north arrows, scales, bylines, and sources to each of your print layout pages.

- **Bonus** -

Step 6: Add a page to your layout to compare one of the ACS variables in this tutorial with the P1 decennial race data from the previous tutorial.

6a Copy your 2010 and 2020 block group shapefile layers and import the data tables you used in the previous tutorial. Join them to their respective shapefiles. Load the Style you saved in the previous tutorial for each layer, being sure to update the changed Field name in the field calculator.

6b Compare the 2010 P1 data with the 2013 ACS data, and the 2020 P1 data with the 2021 ACS data.

Outline specific zones to compare between the two data sets. What correlations do you see between race and the ACS variable?