



Social Vulnerability Index

Use case guide to social vulnerability analysis

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Working with Census Data to Calculate Social Vulnerability

Introduction

The Social Vulnerability Index (SoVI or SVI), developed by [Cutter et al. 2003](#), uses a variety of county-level socioeconomic and demographic indicators to construct an index of social vulnerability to natural hazards. The [Center for Disease Control](#) (CDC) describes social vulnerability as “the potential negative effects on communities caused by external stresses on human health.” Relying on data collected by the [U.S. Census Bureau](#), the SVI is a useful tool that helps to identify geographical variation of social vulnerability across communities and subsequently inform stakeholders where the need is greatest.

Social vulnerability analyses include an array of population characteristics to calculate a vulnerability score; metrics often consist of income status, race and ethnicity, age, gender, residential property (value/quality), renters/homeowners, employment loss, social dependence, education, occupation, rural/urban, family structure, access to medical services, population size, and special needs populations. As the occurrence of climatic extremes, such as flooding, and prolonged drought are expected to increase, assessing social vulnerability is crucial to disaster preparedness.

Nonprofits and community-based organizations working to address disparities of disinvestment, marginalization, high poverty, and vulnerability in their communities can utilize the SVI to not only better understand local population characteristics, but also make stronger cases for targeted investments that advance a community's ability to prepare for, respond to, and recover from environmental hazards. The following guide outlines steps needed to carry out an abbreviated version of a social vulnerability analysis of counties in Kentucky.

Objectives:

- Source and download ACS data from the U.S. Census Bureau
- Format ACS data using Microsoft Excel
- Perform calculations in Excel to identify and rank social vulnerability index scores
- Create two maps comparing resulting SVI scores and percentile ranks for all counties in Kentucky

VIDEO TUTORIAL LINK (to come)

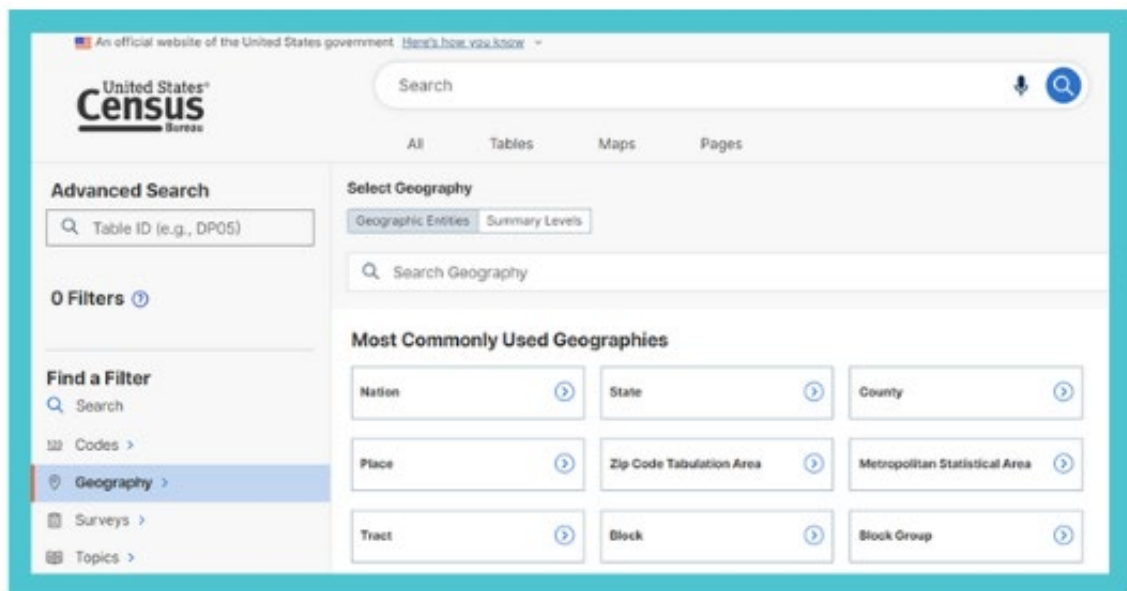
Getting started

DOWNLOADING & VIEWING DATA FROM THE CENSUS BUREAU

1. The U.S. Census Bureau serves as one of the leading publicly available sources of up-to-date, quality data about its people, places and economy. Available datasets include the Decennial Census, which occurs every 10 years, and the

ongoing [American Community Survey](#) offered at 1-, 3- and 5-year intervals beginning in 2000. While the Decennial Census data is the most dependable, ACS data offers reliable and timely insight into changing social, economic, housing and demographic characteristics.

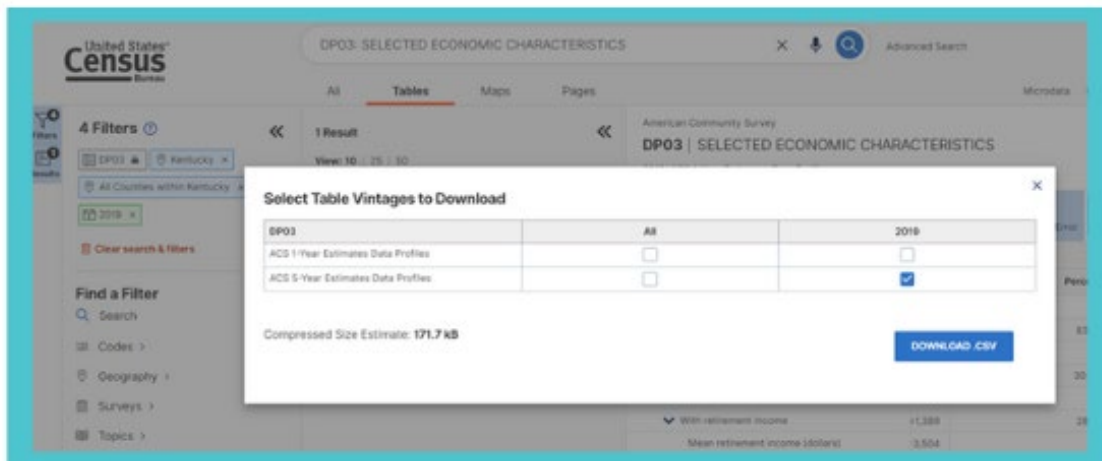
2. Using ACS data, we will loosely follow [methods employed by the CDC](#) to represent characteristics of socially vulnerable populations: **age 65 or older, minority or race, income level, and educational attainment**, and determine SVI scores.
3. To begin, open the browser and navigate to the Census Bureau's data portal: <https://data.census.gov/cedsci/>
4. Select **Advanced Search** then click **Geography**.



5. The American Community Survey provide a diverse collection of tables and profiles that are categorized by subject or topics and cover specific geographic areas. We need to filter the ACS data by topic to extract the correct tables (For more detailed information on ACS data tables and products visit the [Census Bureau ACS Data Tables page](#)).
6. To apply the desired filters, select **County**, then **Kentucky**. Next select **All Counties within Kentucky**. Under the **Years** tab, select **2019**.
7. Navigate to the search bar at the top of the page and type in **DP03**, click search. The letters D & P stand for **Data Profile**, meaning it contains summary statistics on a specific subject profile, e.g. economic, housing, etc.
8. The data profile **Selected Economic Characteristics** should populate. We will use this table to extract a few socioeconomic measures. (NOTE: Near the top, toggle between tables and maps to view different variables and explore what is contained within the table or visualize them in a map.)




9. You'll notice there are two tables available for download: **ACS 1-year Estimate and 5-year Estimate**. We want to **select** and **download** the **ACS 5-year Estimate** table (**as a CSV**) for **year 2019** only. We use the 5-year estimates because they include accumulated data for all years 2015-2019, therefore smaller geographic areas are more accurately captured and the margin of error is reduced.
10. Now we need to download some demographic data to include in the social vulnerability calculation. Return to the search bar and type in **DP05**.



11. The **ACS Housing and Demographic Estimates** table should appear below. Make sure to select the **2019 5-year Estimate** then click **Download CSV**.
12. Return to the search bar and type in **S1501 – Educational Attainment**. The **S** classification indicates to the user that this is a subject table. Subject tables vary only slightly from data profiles where subject tables contain summary statistics by topic, e.g. employment, education, and income.
13. You'll want to ensure the filters we applied earlier (**Year 2019, All Counties in Kentucky**) have not changed so that all our variables align temporally and geographically. Remember to download the **2019 ACS 5-year Estimate** table only.

Data Processing

FORMAT COLUMNS IN EXCEL

14. Now that we have the files we need, we need to set up a storage system for our data. We'll start by extracting our files to a new folder. We will format the data in Microsoft Excel for analysis later.
15. Open the file explorer  on your computer. Create a new project folder where you will save all files. Name the folder **SVI**, then within that folder create a new folder and save it as **ACS_Data**. Begin extracting the contents of the zip files

into this data folder. (NOTE: If any errors occur, delete the files from the data folder and retry the extraction).

16. Once all files have been unzipped, you should see a total of 9 files in your data folder. Note the file names and type (file extension). Each file name indicates what is contained within (profile or subject), the source (ACS) and the year (2019).
17. For each table we downloaded, **DP03, DP05, and S1501**, there are three corresponding documents: a **.txt** file, a **metadata.csv** file and a **data.csv** file. The text and metadata files are provided by the Census Bureau to assist user navigations of the data; together, they provide detailed documentation on data definitions, methodology, design and limitations (NOTE: Visit [Understanding and Using American Community Survey Data: What All Data Users Need to Know](#) to learn more about how to use ACS data).
18. First, open a new **Blank Workbook**. Next, open the **ACSDP5Y2019.DP05-Data** file. We are going to copy and paste only the metrics we need into the new workbook.
19. **Select** the **GEO_ID** and **NAME** column (column A & B) to **right-click → copy & paste** into the new workbook (cell A1). The Census Bureau uses numeric ID codes called GEOID's to uniquely identify all administrative/legal, and statistical geographic areas for the tabulated data.
20. Recall that the **DP05** table contains *estimates on demographic characteristics*. We will use this table to obtain the demographic variables relevant to our vulnerability analysis.
21. Return to the data folder and open the **ACSDP5Y2019.DP05-Column-Metadata** file. The metadata file contains information about each variable; notice how there is an estimate, percent, and margin of error column for each one. The margin of error describes the +/- error of the estimate, while the estimates contain the data we need.
22. In the metadata file, use **Control + F** to search for the following:
 - a. **"Percent!! SEX AND AGE!! Total population"**
 - b. **"Percent!!SEX AND AGE!!Total population!!Female"**
 - c. **"Percent!!SEX AND AGE!!Total population!!Under 18 years"**
 - d. **"Percent!!SEX AND AGE!!Total population!!65 years and over"**
 - e. **Percent!!RACE!!Total population!!One race!!Black or African American"**
 - f. **"Percent!!HISPANIC OR LATINO AND RACE!!Total population!!Hispanic or Latino (of any race)"**
23. For each variable note the column names (**DP05_0001E, DP05_0003PE, DP05_0019PE, DP05_0024PE, DP05_0038PE & DP05_0071PE** respectively).
24. Return to the DP05 data table and use **Control + F** to locate each variable using the column names we just obtained. **Copy & paste** each variable into the new worksheet.
25. Make sure to hit save. Name the file **SVI_DATA** and save the new file in the **SVI** folder as a **.csv NOT a .xlsx file**. Go ahead and close the DP05 data table and



metadata files. Open the **ACSDP5Y2019.DP03-Data** and **ACSDP5Y2019.DP03-Column-Metadata** files.

26. The Census Bureau classifies the total number of people in poverty as the **sum of all people** in families and the number of unrelated individuals with incomes in the last 12 months below the corresponding poverty threshold.
27. Following the same methods found in steps 22-25, we need to find the percentage of all people whose **income in past 12 months is below the poverty level** as one measure of socioeconomic status.
28. As an additional socioeconomic indicator of vulnerability, we'll also include unemployment rates for all counties. In the metadata file, use **Control + F** to filter for "**unemployment rate.**" Using the column name (**DP03_0009PE**) copy & paste the variable into the workbook.
29. Next, open the **ACSST5Y2019.SI501-Data** and **ACSST5Y2019.SI501-Column-Metadata** tables. The final measure of social vulnerability that we need to include is educational attainment. In the metadata file, sort & filter "**Estimate!!Percent!!AGE BY EDUCATIONAL ATTAINMENT!!Population 25 years and over!!9th to 12th grade, no diploma**"
30. We have gathered a total of **8 measures** for our social vulnerability assessment. Depending on the purpose of the SVI assessment, certain metrics are more important to include. For example, this guide focuses on **social** indicators of vulnerable populations, but we could further extend the assessment to include other themes of social vulnerability. Other themes of social vulnerability range from housing, transportation, and access to a vehicle, to household composition English as a second language, and disability.
31. We still need to format columns and rename variables.

Start by renaming:

- a. **GEO_ID** → **GEOID**
- b. **NAME** → **County**

	A	B	C	D	E	F	G	H	I	J	K	L	M
	GEOID	COUNTY	STATE	TOTALPOP	FEMALE	UNDER18	OVER65	BLACK	HISPANIC	POVERTY	UNEMPLO	NODIPLOMA	
1	0500000U	Adair Coun	Kentucky	19222	50.4	19.5	18.6	3.1	2	20.5	5.7	10.9	
2	0500000U	Allen Coun	Kentucky	20944	50.1	23.8	17.3	1	2.2	18.7	5	8.2	
3	0500000U	Anderson C	Kentucky	22409	51	23.9	15.4	2.8	1.8	15.7	7.2	6.3	
4	0500000U	Ballard Co	Kentucky	8032	50.6	22	20.7	4.1	1.4	15.4	6.1	9	
5	0500000U	Barren Cou	Kentucky	43884	51.9	23.9	17.1	3.5	3.2	24.2	6.7	8.7	
6	0500000U	Bath Coun	Kentucky	12355	50.3	25.9	16.2	1.5	1.7	20.4	5.8	11.5	
7	0500000U	Bell Coun	Kentucky	26791	50.8	21.3	18.6	2.8	1.1	35.5	10	16.8	
8	0500000U	Boone Cou	Kentucky	130820	50.3	26.4	12.9	2.9	4.2	7.2	3.8	4.4	
9	0500000U	Bourbon C	Kentucky	20058	52	22.6	18.9	7	6.8	15.3	5.2	9.3	
10	0500000U	Boyd Coun	Kentucky	47682	50	21.3	18.9	2.3	1.8	18.9	7.9	8.1	
11	0500000U	Boyle Coun	Kentucky	29972	49.9	20	18.6	8	3.3	14.2	5.8	8.9	
12	0500000U	Bracken C	Kentucky	8305	49.6	23.9	16.1	0.4	0.8	17.8	4.3	9.1	
13	0500000U	Breathitt C	Kentucky	12977	49.8	20.4	16.5	1.3	0.9	34.4	10	14.3	
14	0500000U	Breckinridj	Kentucky	20176	49.6	22.9	19.3	1.8	1.6	18.6	9.2	10.1	
15	0500000U	Bullitt Cou	Kentucky	80171	50	22.1	15.3	1.1	2	9	4.1	8.2	
16	0500000U	Butler Cou	Kentucky	12764	49.7	22.6	18.1	0.6	3.3	19.3	5.7	10.8	
17	0500000U	Caldwell C	Kentucky	12702	50.8	22.3	20.9	6.3	2.5	16.8	4.7	8.8	
18	0500000U	Calloway C	Kentucky	38837	51.5	18.1	16.8	3.5	2.7	21.5	4.3	6.3	
19	0500000U	Campbell C	Kentucky	92861	51.1	21.2	15.2	3.2	2	13.5	4	6.3	
20	0500000U	Carlisle Co	Kentucky	4784	51.1	22.8	20.6	0.8	2.3	16.8	3.7	10.3	
21	0500000U	Carroll Cou	Kentucky	10671	48.8	25.8	15.1	3.2	6.8	24.1	7.9	13.7	
22	0500000U	Carter Cou	Kentucky	27159	50.9	22.3	18.3	0.6	1.4	25.3	5.8	9.9	
23	0500000U	Casey Cou	Kentucky	15885	51.2	22.7	19.9	0.8	2.9	25.5	8	11.8	
24	0500000U	Christian C	Kentucky	71414	46.8	27.1	12.1	22	7.9	19.6	7.4	8.5	
25	0500000U	Clark Coun	Kentucky	35971	51.2	22.4	17.5	4.7	2.9	14.7	5.6	8.5	
26	0500000U	Clay Coun	Kentucky	20368	47.6	21.3	14.8	3.9	2.6	36.6	9.2	19.2	
27	0500000U	Clinton Co	Kentucky	10193	50	22.8	19.1	0.4	2.8	24.1	6.2	16.2	
28	0500000U	Crittenden	Kentucky	9000	48.9	22.5	20.2	0.8	1.2	14.5	2.1	9.5	




32. For each of the rest of the columns, change the label to the following so we can better identify them:
- c. **DP05_0001E** → **TOTALPOP**
 - d. **DP05_0003PE** → **FEMALE**
 - e. **DP05_0019PE** → **UNDER18**
 - f. **DP05_0024PE** → **OVER65**
 - g. **DP05_0038PE** → **BLACK**
 - h. **DP05_0071PE** → **HISPANIC**
 - i. **DP03_0128PE** → **POVERTY**
 - j. **DP03_0009PE** → **UNEMPLOYMENT**
 - k. **S1501_C02_008E** → **NODIPLOMA**
33. Remove the second row from the table. Highlight **row 2** → **right-click** → **delete**.
34. **Right-click column B** → **insert column**. Ensure that column B (County) is selected. In the ribbon at the top select **Data** → **Text to Columns** → **Delimited** as the file type and hit **Next**.
35. In the following window select **Comma** as the **delimiter** ONLY. Hit **Next** → **Finish**. Notice how 'Kentucky' now has its own column; go ahead and label the column **STATE**. Refer to the example provided to ensure there are no errors.

Social Vulnerability Assessment

CALCULATE INDICES TO PRODUCE FINAL MAP

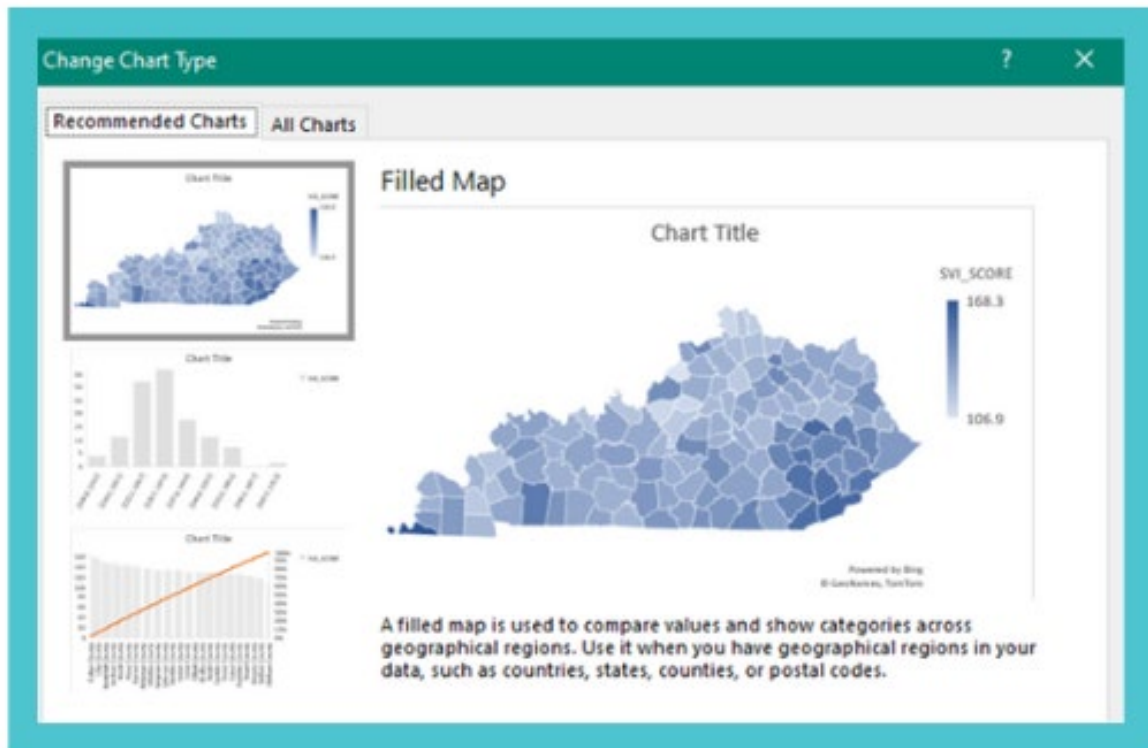
36. The final composite social vulnerability index score is generated using an additive model relying on no *a priori* assumptions about the importance of each variable. In other words, assuming equal importance of each variable, **an SVI score is the unweighted sum of all variables**. Because it is based on **estimates**, the SVI score is only a **relative measure of overall social vulnerability** and cannot be interpreted as absolute.
37. Return to the **Excel SVI** spreadsheet. To calculate the social vulnerability score, add a new column to your table named **SVISCORE**. In the cell below (m2) type in the following formula:
- a. **=SUM(E2, F2, G2, H2, I2, J2, K2, L2)** (NOTE: We included total population to allow for comparisons later, but it is not included in the SVI calculation.)
 - b. Hover the cursor over the corner of the cell. The cursor should change into a white crosshair; **double-click [or click and drag to end of column]** to populate scores for the remainder of the column.
 - c. **Highlight the entire column** → **copy & paste values** into the same column. This step ensures that **values** are stored in the cell, instead of the formula.
38. SVI scores are **unitless values**, e.g. there is no associated unit of measurement. Nonetheless, variables used in this guide are scaled to where **higher values indicate increased social vulnerability, and lower values indicate decreased social vulnerability**.

39. Under the **Data** tab, activate the **Filter**  function for all fields. Under **SVISCORE**, sort from largest to smallest.
40. The county that received the **highest SVI score is Fulton**, followed by Harlan and Wolfe County. Instead of simply tabulating or mapping SVI scores, we are going to determine a **percentile rank of SVI scores** to determine the proportion of counties with high social vulnerability relative to counties with low social vulnerability. By doing this, we can also compare social vulnerability in each county relative to all of Kentucky.
41. A **percentile rank** indicates the percentage of counties that are at or below a particular rank score. We want to know which counties are **at or below the highest SVI index score (168.3)**.
42. In the next column, type in **PERCENTRANKSVI** (make sure that the filter function is applied to this column). In the cell below (N2) type in the following formula:
- =RANK.EQ(M2, \$M\$2:\$M\$122,1)/COUNT(\$M\$2:\$M\$122)** (NOTE: Do not attempt to copy and paste the formula into Excel. This will result in simple errors that can compromise the final SVI rank scores).
 - Repeat hovering the cursor over the cell corner to populate the rest of the percentile ranks.
 -
 - Highlight **PERCENTRANKSVI** (column N). In the ribbon, under the **Home tab** → **Number** → **General**. These values still represent percentages, but using the **General** classification allows the user to input values in the desired format without errors, e.g. Excel will store values how they're entered.

L	M	N
NODIPL	SVI_SCORE	PERCENTRANKSVI
12.1	168.3	100%
16.4	159.5	99%
17.1	158.8	98%
16.8	156.9	98%
17.8	155.6	97%
19.2	155.2	96%
12.9	154.6	95%
14.6	153.4	94%
8.5	151.4	93%
14.8	149.6	93%
14.3	147.6	92%
6.8	147.1	91%
12.5	147	90%
12.8	146.8	89%

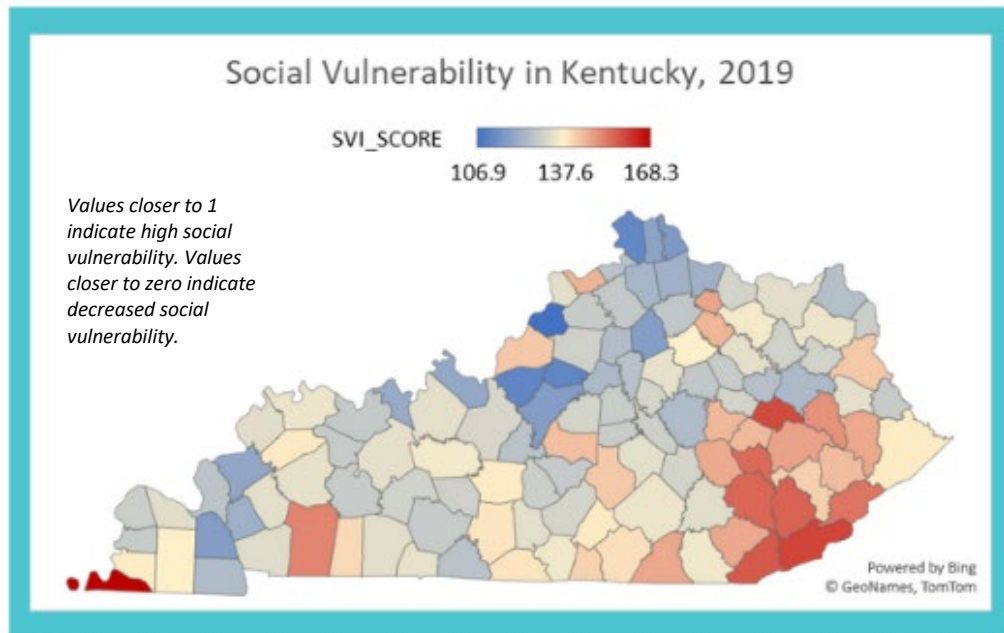
L	M	N
NODIPL	SVI_SCORE	PERCENTRANKSVI
12.1	168.3	1
16.4	159.5	0.991736
17.1	158.8	0.983471
16.8	156.9	0.975207
17.8	155.6	0.966942
19.2	155.2	0.958678
12.9	154.6	0.950413
14.6	153.4	0.942149
8.5	151.4	0.933884
14.8	149.6	0.92562
14.3	147.6	0.917355
6.8	147.1	0.909091
12.5	147	0.900826
12.8	146.8	0.892562

43. The resulting percentages thus reveal the **magnitude of social vulnerability** in each county **relative to the SVI score of Fulton County** (the most socially vulnerable, according to our SVI score).
44. Using the **Filter function** → **sort** the data from **A to Z** using the **COUNTY** column.
45. Scroll down to row 61; notice this row includes estimates for all of Kentucky, not one particular county. Copy the entire row and paste again as the last row. Delete row 61.
46. NOTE: **SVI index score and percentile ranks can be calculated directly in ArcGIS Pro**, however, the user is limited to the version of ArcGIS Pro and available tools. Therefore, for our purposes, calculating the SVI score and percentile ranks in Excel was sufficient.
47. We can create some rudimentary maps using Microsoft Excel because we already have the required geographic data included in the dataset.
48. Using **CTRL + Shift**, select **COUNTY & STATE** (Column B & C) and **SVI_SCORE** (Column M). In the ribbon, select **Insert** → **Recommended Charts** → **select Map**.

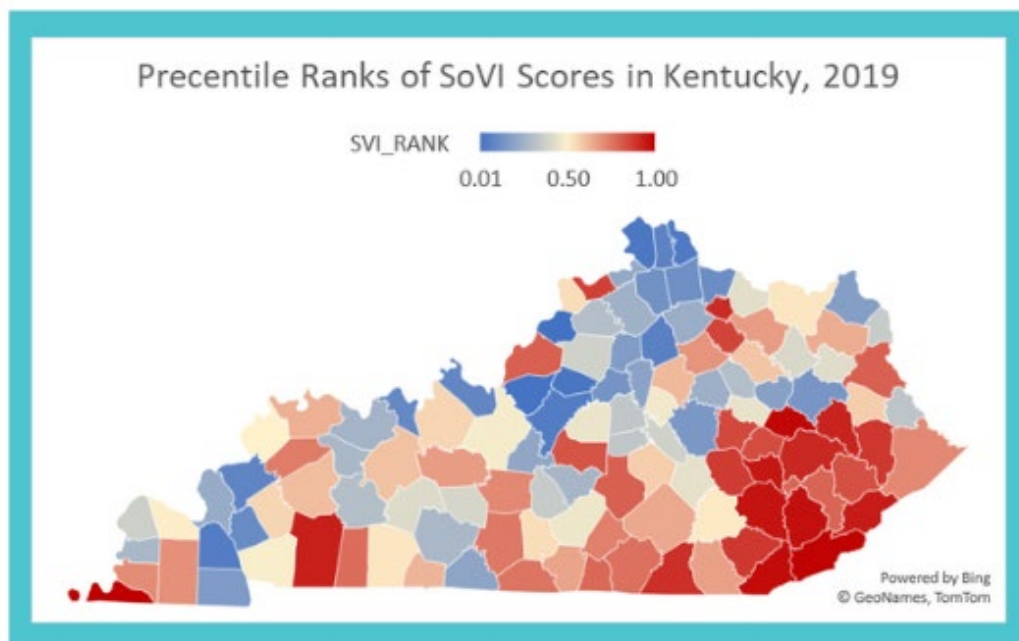


49. Change the map title to **Social Vulnerability in Kentucky, 2019**. To edit map properties, **right-click** → **the specific element** you want to edit to open the properties window pane on the right.
50. We want to change the legend position, map color scheme, as well as the classification. Right-click **Map** → **Format Data Series** → **Series Color** → **select**

Diverging (3-color). Change the **Minimum** color to **blue**, **Midpoint** to **pale yellow**, and **Maximum** to **red**. Leave the defaults as lowest value, midpoint, & highest value.



51. Next, right-click **legend** → **Position** → **Top**. Spend some time in the properties pane editing labels, border outline width and color until you are satisfied with the map.
52. Repeat steps 49-52 to create another map of percentile ranks. Using **CTRL + Shift**, select **COUNTY & STATE** (Column B & C) and **PERCENTRANKSVI**. In the ribbon, select **Insert** → **Recommended Charts** → **select Map**. Edit map properties.




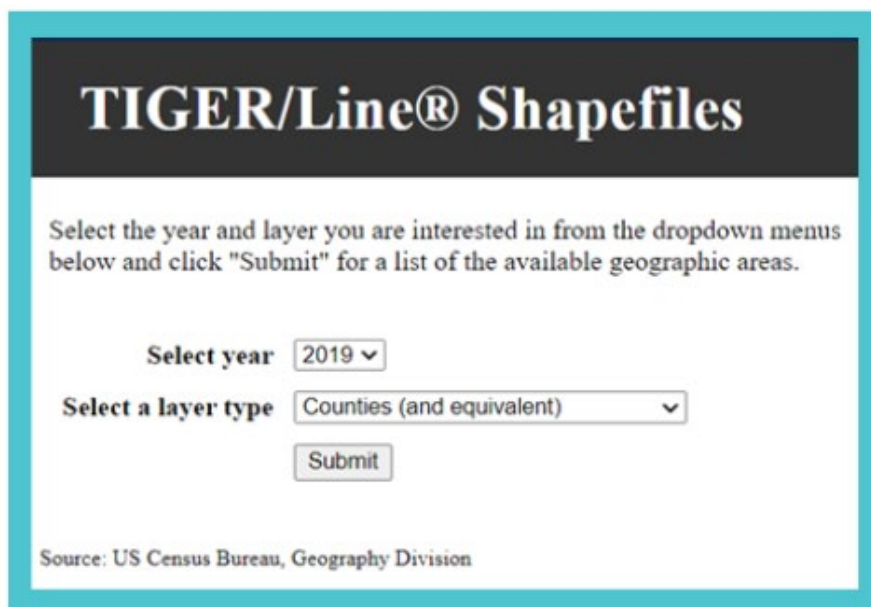
53. While the maps on their own provide a lot of information about social vulnerability in Kentucky, it is recommended to develop a supplementary table of descriptive statistics that offer additional insights into population characteristics.
54. Recall that we included **estimated count of total population** for each county in Kentucky. All other estimates for each metric are represented as a percentage. To enhance final maps, create a table displaying overall social vulnerability in Kentucky, as well as population characteristics in the most socially vulnerable counties (Fulton, Harlan, Wolfe). You can also include population breakdowns of the top 3 least socially vulnerable to better identify where gaps exist.

***If you wish to complete the optional ArcGIS Pro portion of this tutorial, it is recommended that you create a copy of the SVI.csv to work with in the software to avoid errors. ArcGIS Pro can only read single-sheet CSV files and cannot process the maps you create in the workbook.*

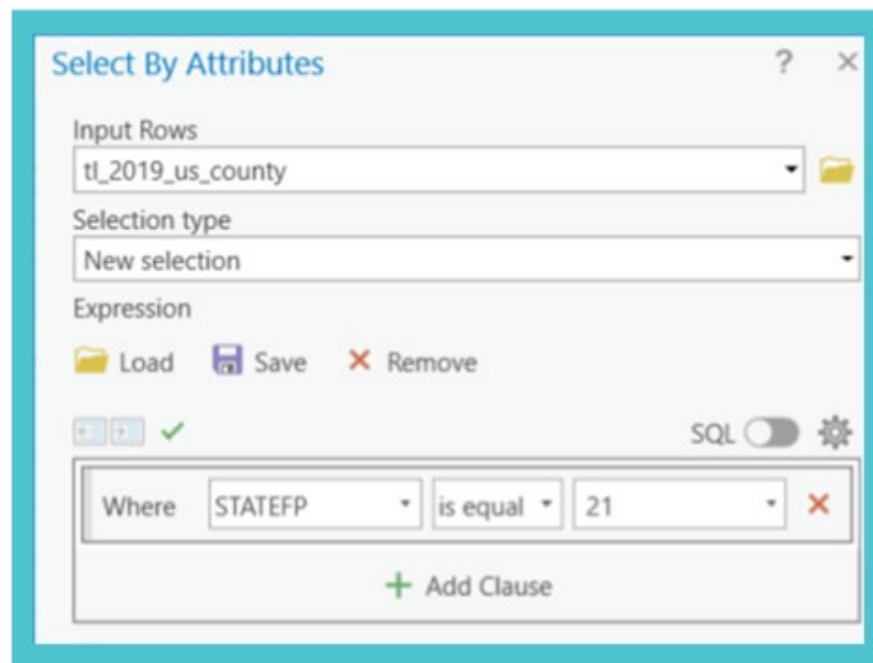
Census Bureau TIGER Files (OPTIONAL)

SOURCING GEOGRAPHIC DATA

55. The following steps are an **OPTIONAL** addition to the guide and are not required to calculate SVI.
56. Social vulnerability assessments serve as key screening measures of how well a community may respond to external disruptions or stressors that negatively impact human health and economic well-being. It is often helpful to include a map displaying the geographic distribution of the final SVI score to supplement tabulated results.
57. To download a shapefile of the U.S. visit the [Census Bureau's TIGER/Line](#) website. Select **Web Interface** .

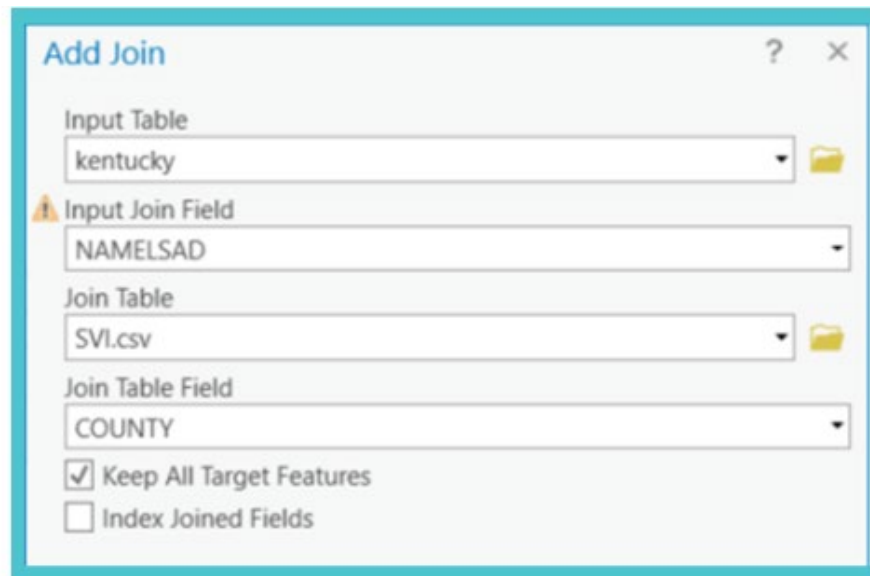


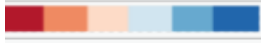
58. Next, for the **year**, select **"2019"**, for **layer type** click the drop-down to select **Counties (and equivalent)** then click submit to **download national file** (To learn more about shapefiles, coverages their applications visit [ESRI ArcGIS online](#) and [Census Bureau](#)).
59. A file named **tl_2019_us_county** should appear. In the **SVI** folder you created earlier, create a new folder and name it **TIGER**. Begin extracting the TIGER/Line zipped file into this folder.
60. Open **ArcGIS Pro**. Create a **New Project** and name is **SVI**. Save it in the project folder (SVI) that we've been working in thus far. Uncheck **Create a new folder for this project** box.





61. In the **Catalog Pane** click the **Folder** drop-down and select (click and drag) the geographic shapefile **tl_2019_us_county.shp** stored in the **TIGER** folder. Additionally, go ahead open the **SVI.csv** file. If you don't see your data, right-click **Folders** → **Add Folder Connection** → **select SVI folder**. (NOTE: If you are unable to open the spreadsheet in ArcPro, ensure that the file is saved as a CSV and NOT a workbook (.xlsx); refresh folder connection and try again).
62. We'll start by using **Select by Attribute** to filter out counties in Kentucky. Open the attribute table for the U.S. shapefile, right-click **feature layer** → **open attribute table**. We'll use the **STATEFP** attribute to select all counties in Kentucky. In the **Select by Attributes** window plug in '**Where 'STATEFP' is equal to 21**' and click OK.
63. The selection should now be highlighted in blue. You will need to export the newly selected attributes to a new feature layer, right-click **tl_2019_us_county.shp** → **Data** → **Export Features**. Name the file **Kentucky** and save it in the **SVI.gdb**.

64. In order to map our SVI scores, we need to join our table data to the geographic shapefile. Open the attribute table for **SVI.csv** and the new **Kentucky.shp** layer. To join data in ArcGIS Pro there must be a *common key* between tables. Take a look at what is contained within each attribute table—column labels can be different, but the attribute must be the same type, e.g. text OR numeric. It looks like we can use **COUNTY** and **NAMESLAD** as the common key for our join.




65. Order matters when joining data. We need to append the **SVI.csv** to our geographic shapefile. To do so, right-click **Kentucky.shp** → **Joins and Relates** → **Add Join**. Click **Run**. Refer to the example to check for errors.
66. Check to see if the join worked by looking at the attribute table. All fields from the **SVI.csv** should be appended to the shapefile. Export the newly joined data as **Kentucky_svi**. Make sure to save in **SVI.gdb**.
67. Lastly, right-click **Kentucky.shp** → **Joins and Relates** → **Remove All Joins**. Remove **Kentucky.shp** from the table of contents.
68. Let's edit Symbolology to display SVI scores. Right-click **Kentucky_svi.shp** → **Symbolology**. A new window will appear on the right. Under **Primary Symbolology** → **Graduated Colors**.
- a. Field: **SVIScore**
 - b. Normalization: None
 - c. Method: **Standard Deviation**
 - d. Interval Size: 1 standard deviation
 - e. Classes: Default (6 classes)
69. Change the color scheme to a diverging (discrete)  color ramp. You can use any color range, but be sure to choose a scheme that can easily distinguish high and low values. (HINT: To reverse symbol order, below **Classes** right-click **Symbol** → **reverse symbol order** to adjust the color ramp).

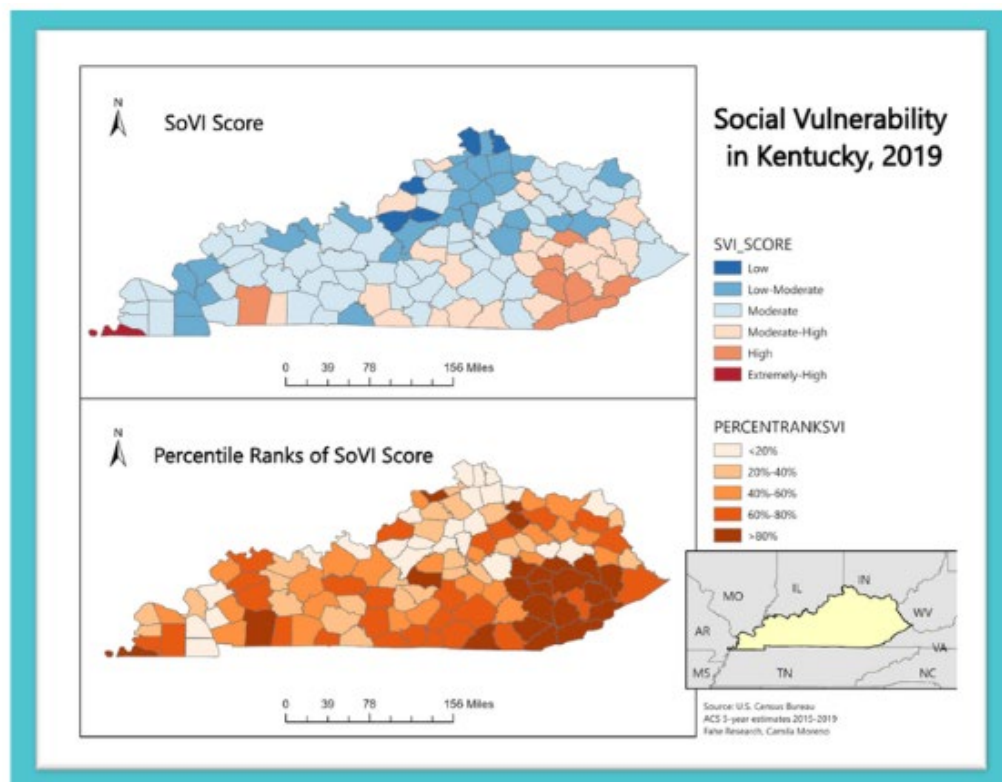
70. Under **Label**, change the label names to **Low, Low-Moderate, Moderate, Moderate-High, High, Extremely-High**.
71. To complement the SVI map, you can **copy & paste** the feature layer to a **New Map**. In the ribbon under **Insert** → **New Map**, paste the map here. Now, change the symbology to the **percentile ranks** attribute we manually calculated in Excel. Change **Method** → **Quantile**. Leave the number of classes (5).
72. Do not close the symbology window. Go to the **Advanced Symbology**  tab, then click the **Format Labels** dropdown → change the **Category to Percentage** → next to **Percentage** select **Number represents a fraction, adjust it to show as a percentage**. Lastly, under **Rounding** → change the **number of decimal places to 0**. (HINT: Change the classification method to see how it changes the map. To learn more about classification methods visit [ESRI: Data Classification Methods](https://www.esri.com/arcgis/learn/data-classification-methods)).
73. Return to **Primary Symbology**. Select a **new color scheme** different from the one used to represent SVI scores. Remember you can reverse symbol order so that darker colors represent high vulnerability and lighter colors represent low vulnerability (**right-click Symbol** → **reverse symbol order**).
74. Change **Labels** to the following: **<20%, 20%-40%, 40%-60%, 60%-80%, >80%**.
75. The last step is to create an **inset map**. Inset maps are a useful tool that provide geographical context to an audience. Return to the ribbon, **Insert** → **New Map**. Open the **Catalog Pane** → **add tl_2019_us_county.shp and Kentucky.shp** to the workspace.
76. Open the ArcToolbox  (also known as geoprocessing pane). Search for **Dissolve** → **Input Features: tl_2019_us_county.shp** → **Output Feature Class: US_dissolve** → **Dissolve Field: STATEFP**. Change the **Symbol** color to a light gray.
77. Repeat the last step for the **Kentucky.shp** file using the **Dissolve** tool. Change to **Symbol** color to another **neutral color**. A dark gray, or pale yellow should work.

Creating Final Maps

ADDING CARTOGRAPHIC ELEMENTS

78. Now we are ready to produce a final map. Return to the ribbon, select **Insert** → **New Layout** → **Landscape - Letter 8.5" x 11"**. Then, import each **Map Frame** to the layout and begin adding map elements.
79. Once you select the **Map Frame**, a crosshair cursor will appear when you hover over the page. Click and drag the frame to adjust the size to where the margins are equal, but ensuring that both maps can easily fit.
80. You can further adjust the positioning of the map itself by activating the map frame. In the **Contents**, **right-click Map Frame > Activate**. To exit simply click **Back to Layout** at the top.  **Layout : Map Frame** Make sure to leave ample space to add in cartographic elements, such as, a **scale bar, North arrow, and legend**.

81. In the ribbon, under the **Insert tab**, the **Map Surrounds** box contains all the elements you will need to make the final map. Click each element one at a time then click the cursor in the white space to add each element.
82. To edit map elements, **right-click on the element > properties**. Alternatively, you may double-click the desired element in the **Contents** to open its properties. In the window on the right you can modify text fonts and size, labels, and placement and positioning of all the map elements. (NOTE: For additional information on formatting map elements visit [ESRI: Layouts and Map Surrounds](#) to learn more).
83. Add a **title** for the map, in addition to a simple reference title for both maps to inform the audience of map content. To add a title, click **Straight Text** and then click and drag the cursor to insert the text box. Name the map **"Social Vulnerability in Kentucky, 2019."**
84. Add the last **Map Frame** that you'll use for the **inset map**.
85. Remember to add a **citation** for the data, (e.g. U.S. Census Bureau ACS 5-year Estimates 2015-2019) and your name as the author.
86. Finally, to export map navigate to the ribbon and select **Share > Export Layout**. On the right export the map as a PNG file. PNG is the recommended file type for exported GIS products that may need to be shared online or inserted in other documents because it preserves text and lines best. Name the output **SVI_final_map** and make sure to save in your project folder. The final map should look similar to the example provided.
87. Compare results to the [CDC's SVI map](#).



****Disclaimer:** All data used in this tutorial was obtained from the U.S. Census Bureau. Analysis methods were loosely modeled using the CDC SVI methodology. No measures were taken to account for high margins of error. It is common for smaller geographic and rural areas to have higher margins of errors due to smaller sample sizes, but for publication purposes, the author encourages users to account for high margins of error and include additional resources to complete a comprehensive social vulnerability analysis.

Limitations to consider:

The social vulnerability index is used by a variety of local and federal government agencies, public health officials, planners, emergency responders, and academics as a planning tool to evaluate a community's ability to respond to environmental hazards. Drawing together from a range of socioeconomic, demographic, and housing/transportation measures, the SoVI score illuminates not only geographical variation of vulnerability, but also unearths the type of support needed to reduce impacts related to both natural- and human-caused disturbances. Nonetheless, the use of SoVI assessments are inherently subjective and are typically conducted for a specific purpose. It is therefore important to understand that SoVI scores are only a relative measure of social vulnerability, and are only as accurate as the data used to calculate SoVI scores. For example, SoVI scores for a particular region can change depending on the measures used to characterize vulnerable populations, as well as the importance placed on such measures. It is increasingly recognized that local assessments of social vulnerability are more reliable and future assessments should consider involving local experts and available data to support future planning.

Sources

[American Community Survey Data Tables](#)

[American Community Survey & Puerto Rico Community Survey: Subject Definitions](#)

[CDC/ATSDR SVI Fact Sheet](#)

[Climate Change and Social Vulnerability in the United States](#)

[Community Based Vulnerability Assessment](#)

[Methods for CDC Social Vulnerability Index](#)

[Practical Guide to the SVI](#)

[Ultimate Guide to using Excel](#)

[Understanding and Using American Community Survey Data: What All Users Need to Know](#)

[United States Census Bureau: American Community Survey](#)