

Oregon Cascades West Council of Governments Vulnerability Index Technical Methodology Overview

In order for decision makers to develop policies and strategies to better plan for citywide resilience, efforts much acknowledge and account for the varying level of social vulnerability in neighborhoods across the community. To that end, the Oregon Cascades West Council of Governments Vulnerability Index (VI) combines standardized values of eight separate indicators collected from the United States Census Bureau's American Community Survey (ACS) to illustrate vulnerability: poverty, race, advanced age (65+), disability, limited English proficiency (LEP), households with children present, level of educational attainment, and rental tenure.

The use of census data offers the significant benefit of analysis of trends over time. It also allows mapping at the census block group level, providing detailed information of communities of approximately 600 to 3,000 people. With the ability to overlay maps, the VI tool provides valuable data-based visuals for community resilience policies and strategies.

The first step in creating this index was to obtain the relevant data from the ACS 2019 body of data. Below is a list of the specific tables used as part of the organization's VI tool:

- Population Living Below the Poverty Line (Table B17021)
- Minority Population (Table B02001)
- Senior Population (Table B01001)
- Persons with Disabilities (Table B18101)*
- Limited English Proficiency (LEP) Population (Table C16002)
- Presence of Children in the Household (Table B11012)
- Attained High School Degree or Equivalent (Table B15003)
- Percentage of Renters as tenure type (Table B25003).

*this table is only available down to the census-tract level, so data has been replicated in the block groups of that individual census tract.

Each table was filtered for the block group level for areas within the COG's boundary (see note on Table B18101) and downloaded. Then, according to the requirements of each topic table, appropriate columns were tallied, and percentages were calculated. Finally, the distilled information from the various topics was combined into a single dataset.

Since the ability to map the VI tool data was a significant priority, the combined data table of ACS data for all topics was joined to the official census 2019 block groups shapefile within ArcPro for the AAMPO area, and the CAMPO area. The percentage of occurrence for each topic in a given block group was analyzed to determine the Equal Intervals for the required area and given a ranking of 1-5 to represent the value range for that topic, 1 being the lowest risk and 5 being the highest. Once each data topic had a risk ranking, the sum of the eight topic rankings formed the overall Vulnerability Index for that block group.

What follows is a breakdown of how a single topic – Seniors (65+) – was handled through this process.

1. The B01001 Table data for ACS 2019 was obtained from the US Census site using area block groups as a filter:

United States Census Bureau

B01001

Advanced Search

Microdata Help FAQ Feedback

6 Filters

1 Result

American Community Survey

B01001 | SEX BY AGE

2018: ACS 5-Year Estimates Detailed Tables | Universe: Total population

Notes Geos Years Topics Surveys Codes Hide Transpose Margin of Error Restore Excel CSV ZIP Share Print Map

Label	United States		Block Group 1, Census Tract 1, Benton County, Oregon		Block Group 2, Census Tract 1, Benton County, Oregon	
	Estimate	Margin of Error	Estimate	Margin of Error	Estimate	Margin of Error
Total:	324,697,795	*****	1,394	±281	1,551	±281
Male:	159,886,919	±5,817	676	±160	904	±160
Under 5 years	10,112,614	±3,826	12	±21	124	±21
5 to 9 years	10,276,829	±16,598	0	±12	20	±12
10 to 14 years	10,708,022	±16,572	0	±12	28	±12
15 to 17 years	6,429,069	±3,398	0	±12	97	±12
18 and 19 years	4,411,135	±5,291	11	±20	0	±20
20 years	2,352,092	±13,695	66	±76	0	±76
21 years	2,303,286	±14,015	0	±12	0	±12
22 to 24 years	6,639,841	±18,381	130	±93	84	±93
25 to 29 years	11,737,463	±4,900	109	±76	300	±76
30 to 34 years	11,073,985	±4,231	58	±49	0	±49
35 to 39 years	10,520,984	±19,642	47	±38	48	±38
40 to 44 years	9,904,665	±20,566	42	±38	16	±38
45 to 49 years	10,257,969	±4,596	16	±26	0	±26

This area was further reduced so that it only contained block groups within the specified AAMPO or CAMPO area. Furthermore, some block groups extended beyond the CAMPO or AAMPO boundaries. The block groups were clipped by the MPO boundaries. The data for the entire block group was still used. The assumption is that most of the population density lives within the MPO boundaries.

- Each table of data required specific calculations to facilitate analysis. Since the B01001 Table details many age ranges, it was necessary to combine several ranges to reflect the total population aged 65 and older (columns used highlighted below: : 'B01001_001E', 'B01001_020E', 'B01001_021E', 'B01001_022E', 'B01001_023E', 'B01001_024E', 'B01001_025E', 'B01001_044E', 'B01001_045E', 'B01001_046E', 'B01001_047E', 'B01001_048E', B01001_049E').

Table B01001 – Column Metadata

Column Name	Column Metadata	Column Name	Column Metadata
B01001_001E	Estimate!!Total:		
B01001_002E	Estimate!!Total:!!Male:	B01001_026E	Estimate!!Total:!!Female:
B01001_003E	Estimate!!Total:!!Male:!!Under 5 years	B01001_027E	Estimate!!Total:!!Female:!!Under 5 years
B01001_004E	Estimate!!Total:!!Male:!!5 to 9 years	B01001_028E	Estimate!!Total:!!Female:!!5 to 9 years
B01001_005E	Estimate!!Total:!!Male:!!10 to 14 years	B01001_029E	Estimate!!Total:!!Female:!!10 to 14 years
B01001_006E	Estimate!!Total:!!Male:!!15 to 17 years	B01001_030E	Estimate!!Total:!!Female:!!15 to 17 years
B01001_007E	Estimate!!Total:!!Male:!!18 and 19 years	B01001_031E	Estimate!!Total:!!Female:!!18 and 19 years
B01001_008E	Estimate!!Total:!!Male:!!20 years	B01001_032E	Estimate!!Total:!!Female:!!20 years
B01001_009E	Estimate!!Total:!!Male:!!21 years	B01001_033E	Estimate!!Total:!!Female:!!21 years
B01001_010E	Estimate!!Total:!!Male:!!22 to 24 years	B01001_034E	Estimate!!Total:!!Female:!!22 to 24 years
B01001_011E	Estimate!!Total:!!Male:!!25 to 29 years	B01001_035E	Estimate!!Total:!!Female:!!25 to 29 years
B01001_012E	Estimate!!Total:!!Male:!!30 to 34 years	B01001_036E	Estimate!!Total:!!Female:!!30 to 34 years
B01001_013E	Estimate!!Total:!!Male:!!35 to 39 years	B01001_037E	Estimate!!Total:!!Female:!!35 to 39 years
B01001_014E	Estimate!!Total:!!Male:!!40 to 44 years	B01001_038E	Estimate!!Total:!!Female:!!40 to 44 years
B01001_015E	Estimate!!Total:!!Male:!!45 to 49 years	B01001_039E	Estimate!!Total:!!Female:!!45 to 49 years
B01001_016E	Estimate!!Total:!!Male:!!50 to 54 years	B01001_040E	Estimate!!Total:!!Female:!!50 to 54 years
B01001_017E	Estimate!!Total:!!Male:!!55 to 59 years	B01001_041E	Estimate!!Total:!!Female:!!55 to 59 years
B01001_018E	Estimate!!Total:!!Male:!!60 and 61 years	B01001_042E	Estimate!!Total:!!Female:!!60 and 61 years
B01001_019E	Estimate!!Total:!!Male:!!62 to 64 years	B01001_043E	Estimate!!Total:!!Female:!!62 to 64 years
B01001_020E	Estimate!!Total:!!Male:!!65 and 66 years	B01001_044E	Estimate!!Total:!!Female:!!65 and 66 years
B01001_021E	Estimate!!Total:!!Male:!!67 to 69 years	B01001_045E	Estimate!!Total:!!Female:!!67 to 69 years
B01001_022E	Estimate!!Total:!!Male:!!70 to 74 years	B01001_046E	Estimate!!Total:!!Female:!!70 to 74 years
B01001_023E	Estimate!!Total:!!Male:!!75 to 79 years	B01001_047E	Estimate!!Total:!!Female:!!75 to 79 years
B01001_024E	Estimate!!Total:!!Male:!!80 to 84 years	B01001_048E	Estimate!!Total:!!Female:!!80 to 84 years
B01001_025E	Estimate!!Total:!!Male:!!85 years and over	B01001_049E	Estimate!!Total:!!Female:!!85 years and over

The resultant sum was then divided by the total population for the block group (column 'B01001_001E') and multiplied by 100 to get the total percentage of people 65 and older in the block group. The results of these calculations for this table are shown in the next step.

- The data was joined to the official 2019 census shapefile for the AAMPO or CAMPO area and the Equal Intervals were calculated.

	A	B	C	D	E	F	G
1	GEO_ID	FIPS_text	Density_TotalPop	Senior_TotalCount	Senior_TotalPer	SenPer_EI	SenPer_EI_RANGE
2	1500000US410030001001	ID 410030001001	1194	102	8.542713568	2	7.605365 - 15.210728
3	1500000US410030001002	ID 410030001002	1551	145	9.348807221	2	7.605365 - 15.210728
4	1500000US410030001003	ID 410030001003	1333	173	12.97824456	2	7.605365 - 15.210728
5	1500000US410030001004	ID 410030001004	3534	353	9.988681381	2	7.605365 - 15.210728
6	1500000US410030002021	ID 410030002021	1386	453	32.68398268	5	30.421457 - 38.026820
7	1500000US410030002022	ID 410030002022	3989	650	16.29481073	3	15.210729 - 22.816092
8	1500000US410030004001	ID 410030004001	2388	425	17.79731993	3	15.210729 - 22.816092
9	1500000US410030004002	ID 410030004002	2913	503	17.2674219	3	15.210729 - 22.816092
10	1500000US410030004003	ID 410030004003	1710	303	17.71929825	3	15.210729 - 22.816092
11	1500000US410030004004	ID 410030004004	1044	397	38.02681992	5	30.421457 - 38.026820
12	1500000US410030005001	ID 410030005001	1024	330	32.2265625	5	30.421457 - 38.026820

This example is for Row 2 in the graphic above (highlighted with an orange arrow):

Column A	GEO_ID	'1500000US410030001001' is the official Census reference ID for this block group.
Column B	FIPS_text	This is a shortened version of the GEO_ID which is used for internal reference in GIS.
Column C	Density_TotalPop	This column holds the total population in the block group. There are 1194 persons in this block group.
Column D	Senior_TotalCount	This column holds the total number of seniors in the block group. There are 102 persons aged 65+ in this block group.
Column E	Senior_TotalPer	This column holds the percentage of seniors in the total population for the block group. Persons aged 65+ make up 8.5% of the population in this block group.

As a classification type, Equal Intervals divides values into equal size ranges. For this tool, the algorithm was asked to calculate five classes for the percentage data (the ranges for this topic for the CAMPO area are shown in the table below).

Class 1	0.000000 - 7.605364
Class 2	7.605365 - 15.210728
Class 3	15.210729 - 22.816092
Class 4	22.816093 - 30.421456
Class 5	30.421457 - 38.026820

The resultant five classes and their specified ranges were used to assign a class number to the block group (SenPer_EI) and then show the range that the number fell within (SenPer_EI_RANGE).

Column F	SenPer_EI	This column holds the number 1-5 based on the Equal Intervals calculation. Based on the Equal Intervals on this topic for this area, the data for this block groups falls within the second class.
Column G	SenPer_EI_RANGE	This column holds the range for the class this block groups falls within. This block group has a risk level of '2' which falls within the second lowest range of the calculated Equal Intervals, 7.605365 - 15.210728.

- The relative class numbers for each of the 8 data topics were then summed to calculate the overall Vulnerability Index number (shown as 'EquityIndexSum' in the image) for that block group. The "2" classification for the Senior population in the highlighted block group contributed to the overall index number of "18".



OBJECTID *	OID_	GEO_ID	FIPS	FIPS_text	CensusTract	County	PovPer_EI	MinPer_EI	SenPer_EI	LEPPer_EI	DisPer_EI	ChiPer_EI	HS_Per_EI	RenPer_EI	EquityIndexSum
1	1	1500000US4100300010...	410030001001	ID 410030001001	100	3	3	1	2	1	3	1	3	4	18
2	2	1500000US4100300010...	410030001002	ID 410030001002	100	3	3	2	2	1	3	4	4	4	23
3	3	1500000US4100300010...	410030001003	ID 410030001003	100	3	2	3	2	1	3	4	2	2	19
4	4	1500000US4100300010...	410030001004	ID 410030001004	100	3	2	3	2	1	3	5	3	2	21
5	5	1500000US4100300020...	410030002021	ID 410030002021	202	3	1	2	5	1	3	4	2	1	19
6	6	1500000US4100300020...	410030002022	ID 410030002022	202	3	2	4	3	2	3	3	1	3	21
7	7	1500000US4100300040...	410030004001	ID 410030004001	400	3	2	3	3	3	3	4	2	3	23
8	8	1500000US4100300040...	410030004002	ID 410030004002	400	3	2	4	3	3	3	5	1	2	23
9	9	1500000US4100300040...	410030004003	ID 410030004003	400	3	2	3	3	3	3	4	1	3	22

- Finally, the Vulnerability Index numbers were displayed as a layer on a map to visually show the relative vulnerability of block groups across the CAMPO area. The Vulnerability Index Sum was divided using Quantiles. The quantile method divides classes so that the total number of features in each class is approximately the same. Therefore, low risk will have approximately the same number as features (block groups) as high risk. The block group from this example is highlighted on the map below.

