Updated Coastal Virginia Social Vulnerability Index at the Block Group Level
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Following other social vulnerability indexes, including the SoVI® developed by the Hazards & Vulnerability Research Institute at the University of South Carolina, this vulnerability index is based on a principal component analysis (PCA). PCA is a statistical technique that takes as its input a matrix of interrelated socioeconomic variables – in this case those considered to measure various dimensions of social vulnerability – and creates a new set of orthogonal principal components that extract the important variation the underlying input data while reducing the noise and redundancy in the data. After conducting the PCA, the researcher combines the newly created component variables into a composite index that provides a single value for each observation in the dataset, in this case a social vulnerability score. The utility of a PCA-based index is that it encapsulates a lot of information in an easily consumed form and individual observations can be ranked relative to each other.

This update uses data from the 2015-2019 American Community Survey at the census block group level where available and at the census tract level where block group data is not available. It is an update of the Social Vulnerability Index on the Adapt VA Portal and uses the same or similar variables to the ones used in that analysis. These variables, shown in the next table, are those that we consider to be the most direct determinants of social vulnerability.

Variable	Description	Block Group or Tract Level
Income	Per capita income	Block Group
Black	Percent of population that is Black or African American	Block Group
Hispanic	Percent of population that is Hispanic	Block Group
Native	Percent of population that is Native American	Block Group
Over 65	Percent of population that is over 65 years of age	Block Group
Unemployed	Percent of civilian labor force 16 and over that is unemployed	Block Group
Poverty	Percent of population for whom poverty status is established that is living in poverty	Tract
No High School	Percent of population 25 and older with no high school degree or equivalent	Block Group
Group Quarters	Percent of population in group quarters including nursing homes and prisons	Tract
Female Labor Force	Percent of females 16 and over in civilian labor force	Tract
Female Households	Percent of households with female head, no spouse	Block Group
Social Security	Percent of households with social security income	Block Group

Before conducting the PCA, the variables were first standardized to z-scores with zero means and unit variances to avoid any confounding effects that might arise from using variables of different magnitudes in the analysis. We then conducted a PCA, keeping those components with eigenvalues greater than 1 (the Kaiser selection criterion). As a next step, we conducted a Varimax rotation of the components to facilitate interpretation of each component because – as is the case with all PCA-based indices – the researcher must determine the directionality of each retained component, that is whether higher values of the component increase the level of social vulnerability (positive directionality) or decrease the level of social vulnerability (negative directionality). Where the directionality of the component was clearly negative, we scaled the component by a factor of -1 before including it in the composite index so that higher values of the scaled component would increase the overall vulnerability index. As is common in the literature, in instances when the effect of the component on vulnerability is ambiguous (as is the

case when the different variables that make up the component work in opposite ways), we assume a positive directionality. Each component is then multiplied by the variance it captures from the total input matrix and the weighted components are added together to form the index. To ensure that the index can be compared to other indices, the resulting aggregated values to z-scores with zero means and unit variances. Since all values of the index are relative, it can be used to rank observations relative to each other in terms of vulnerability. However, many studies also identify a group of "highly vulnerable" observations – that is those observations whose standardized index score exceeds a threshold value of 1 (i.e., whose value is one standard deviation above the mean value of the index). We note that vulnerability indices depend on the variables included in the PCA as well as the geographic area of the study and the component selection and weighting criteria. Thus our vulnerability index will not necessarily match the vulnerability indices created by other researchers.

Authors:
Stafford, Sarah and Vander Schaaf, Schyler, "Coastal Virginia Social Vulnerability Index at the Block Group Level" (2021). Data. William & Mary.