

Assessing Relative Agreement in Ranking Rhode Island Census Tracts Across the Social Vulnerability Index and the Enviornmental Justice Index

Thesis for a Master of Public Health, Epidemiology

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Note: the table of contents acts as in-document hyperlinks

Purpose Statement

This purpose of this document is assess the relative agreement of Rhode Island census tracts across the Social Vulnerability Index, Environmental Justice Index, and the Rhode Island Health Equity Index. The index values of interest include the overall vulnerability value and the values associated with sub themes found in all indices. The latter of which will not be compared because there is no consistency in the themes.

In the first half of the document, all indices will be cleaned, and feature engineer the desired quantiles (i.e., 3, 4, 5 & 10). In the second half of the document, the Kappa coefficient will be calculated. The Appendix will include maps of the spatial distribution of the index values.

Cleaning Indices and Feature Engineering Quantiles

Social Vulnerabilty Index Variables

Variables that will be pulled from the SVI include: the summary variable and the 4 theme specific variables (i.e., Socioeconomic Status, Household Characteristics, Racial & Ethnic Minority Status, Housing Type & Transportation). The SVI data contains 247 census tracts, however the Census Bureau states that [244 tracts exist](#).

Enviornmental Justice Index

The variables pulled from the EJI include: the overall summary value and the EJI 3 theme specific variables (i.e., Environmental Burden, Social Vulnerability, Health Vulnerability). The EJI contains 243 census tracts, however the Census Bureau states that [244 tracts exist](#).

Identification of the Missing Census Tracts

The missing census tracts stem from the indices using two different sets of FIPS codes, hence different both census use different spatial definitions. This is evident by the fact that the two maps of the summary index values found in Appendix A. The EJI uses 2010 FIPS codes, while the SVI uses 2022 FIPS codes. Even though the visual difference between the two indices occurs from the larger EJI tracts contains two smaller current SVI tracts, the smaller SVI summary values cannot be combined because they represent percentile ranks. Attempts to combine and calculate weighted Cohen's kappa would lead to incorrect or inaccurate results.

```
## [1] "12 Census Tracts that appear in the SVI but do not appear in the EJI"
```

##	FIPS	LOCATION
## 1	44005040104	Census Tract 401.04; Newport County; Rhode Island
## 2	44005040105	Census Tract 401.05; Newport County; Rhode Island
## 3	44007000301	Census Tract 3.01; Providence County; Rhode Island
## 4	44007000302	Census Tract 3.02; Providence County; Rhode Island
## 5	44007001601	Census Tract 16.01; Providence County; Rhode Island
## 6	44007001602	Census Tract 16.02; Providence County; Rhode Island
## 7	44007002801	Census Tract 28.01; Providence County; Rhode Island
## 8	44007002802	Census Tract 28.02; Providence County; Rhode Island
## 9	44007011404	Census Tract 114.04; Providence County; Rhode Island
## 10	44007011405	Census Tract 114.05; Providence County; Rhode Island
## 11	44009050701	Census Tract 507.01; Washington County; Rhode Island
## 12	44009050702	Census Tract 507.02; Washington County; Rhode Island

```
## [1] "6 Census Tracts that appear in the EJI but do not appear in the SVI"
```

##	FIPS	Location
## 1	44005040103	Census Tract 401.03, Newport County, Rhode Islan
## 2	44007000300	Census Tract 3, Providence County, Rhode Island
## 3	44007001600	Census Tract 16, Providence County, Rhode Island
## 4	44007002800	Census Tract 28, Providence County, Rhode Island
## 5	44007011401	Census Tract 114.01, Providence County, Rhode Is
## 6	44009050700	Census Tract 507, Washington County, Rhode Islan

Calculating Kappa Coefficient for Overall Indices Value

Weighted Cohen's kappa is a measure of the agreement between two ordinarily scaled samples, this is the variable estimate of interest because the samples are ordinal.

Assumptions for Weighted Cohen's Kappa include:

1. Your data should met the following assumptions for computing weighted kappa.
2. You have two outcome categorical variables, which should be ordinal
3. The two outcome variables should have exactly the same categories
4. You have paired observations; each subject is categorized twice by two independent raters or methods.
5. The same two raters are used for all participants.

Given the second assumption an inner join must be preformed to ensure that all paired observations have been categorized twice by the two indices.

Statistical Hypothesis include:

- **Null Hypothesis:** $\kappa = 0$
- **Alternative Hypothesis:** $\kappa \neq 0$

The following interpretations will be implemented:

- values greater than 0.75 or so may be taken to represent excellent agreement beyond chance,
- values below 0.40 or so may be taken to represent poor agreement beyond chance, and
- values between 0.40 and 0.75 may be taken to represent fair to good agreement beyond chance.

Joseph L. Fleiss, Myunghee Cho Paik, Bruce Levin. 2003. Statistical Methods for Rates and Proportions. 3rd ed. John Wiley; Sons, Inc.

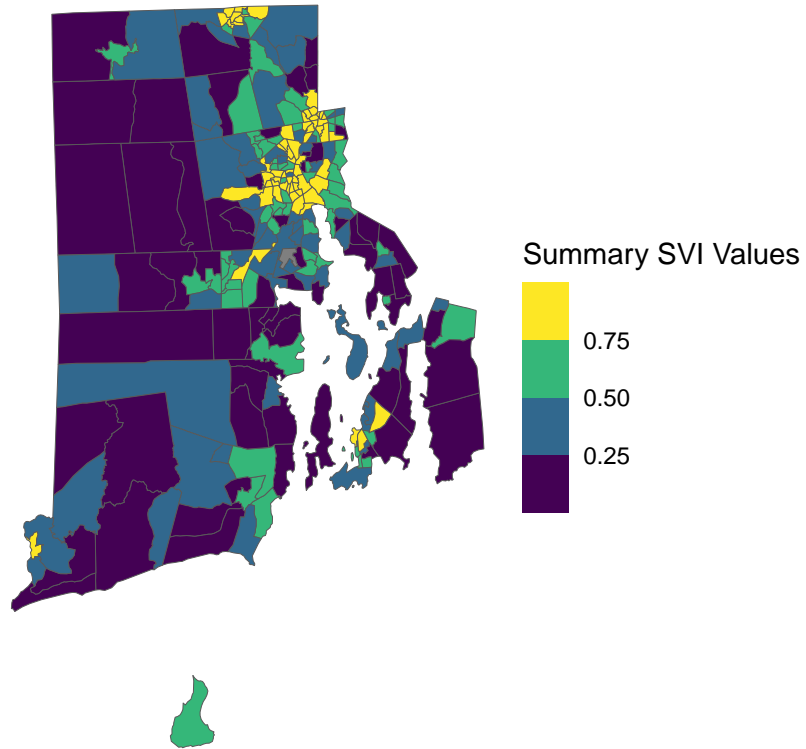
Quantiles	Weighted κ (95% CI)
Terciles	0.64 (0.56, 0.72)
Quartiles	0.64 (0.56, 0.72)
Quintiles	0.68 (0.61, 0.75)
Deciles	0.69 (0.61, 0.75)

There is good agreement across all indices regardless of the quantiles being used.

Appendix A - Spatial Distribution of Index Values

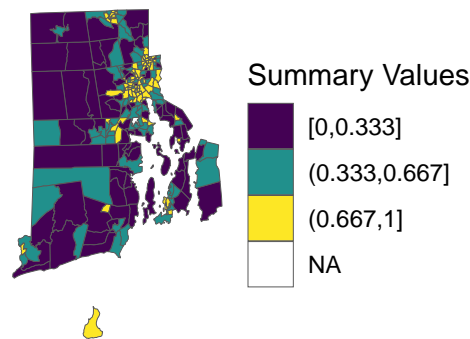
SVI Maps

Spatial Distribution of Summary SVI Values, 2022

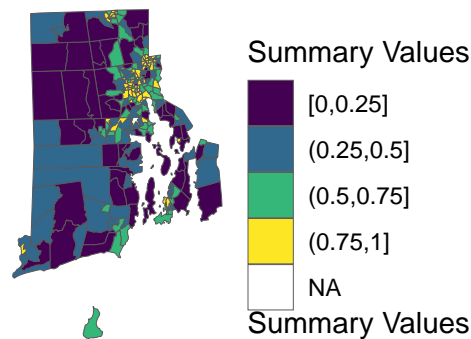


Quantile Maps of Social Vulnerability Index, 2022

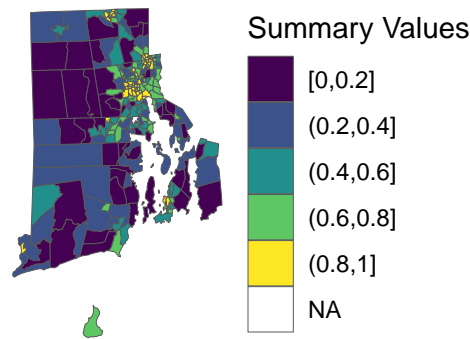
Tertiles



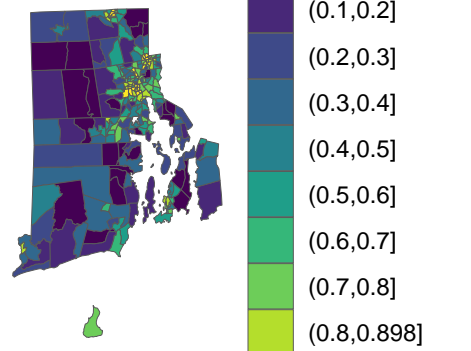
Quartiles



Quintiles

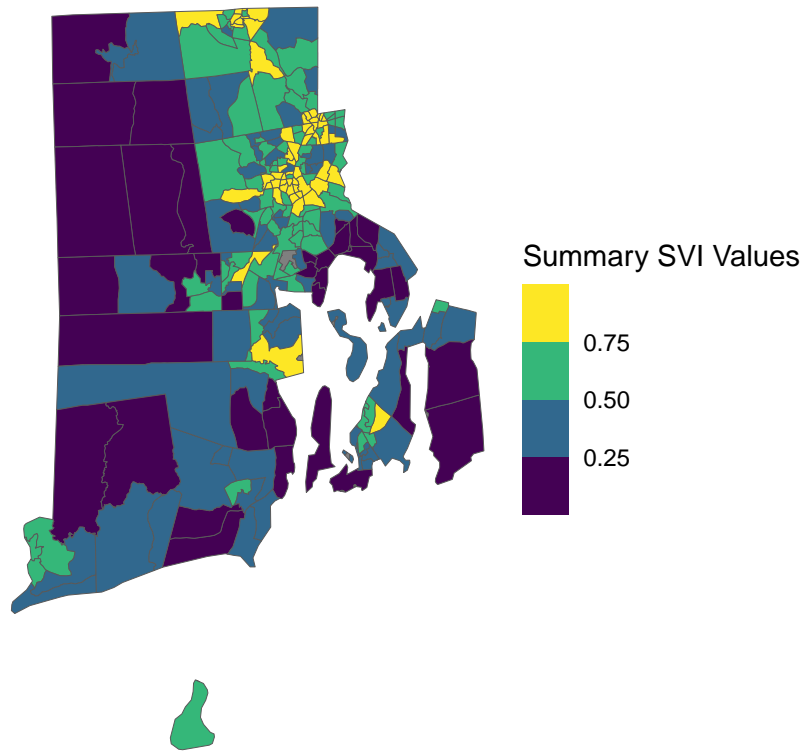


Deciles



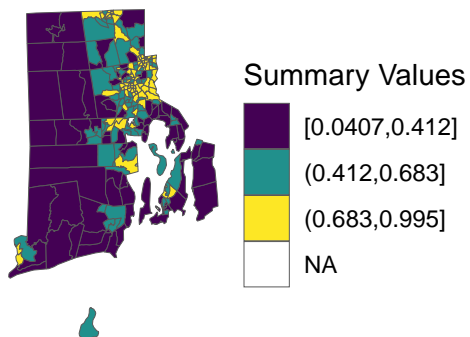
EJI Maps

Spatial Distribution of Summary SVI Values, 2022

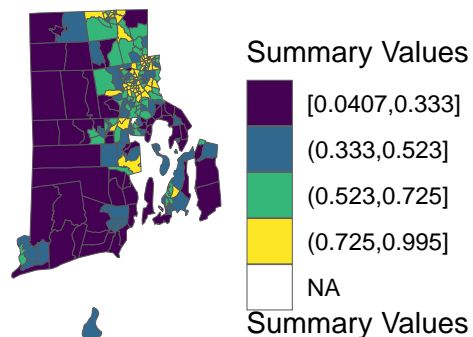


Quantile Maps of Environmental Justice Index, 2022

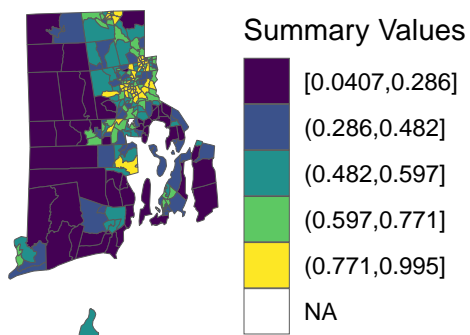
Tertiles



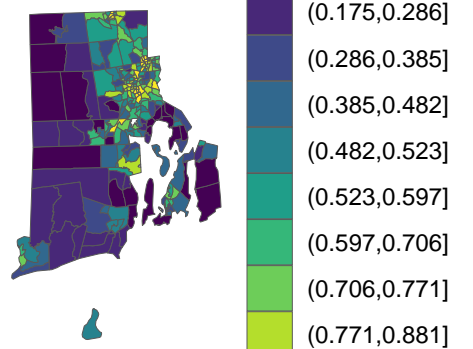
Quartiles



Quintiles



Deciles

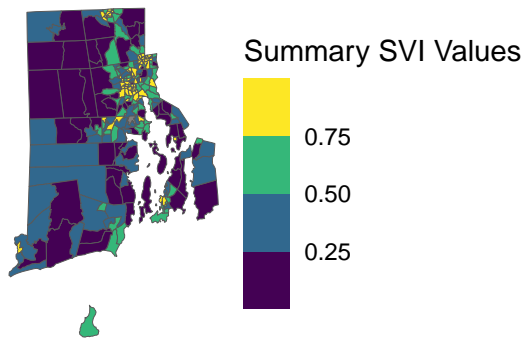


Distribution of Themes within Each Indices

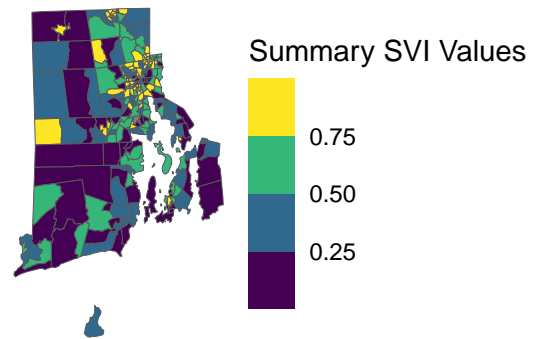
The SVI contains 4 themes, and the distribution of those themes are shown below. Quantiles of these values will be made available upon request.

Maps of Social Vulnerability Index Themes, 2022

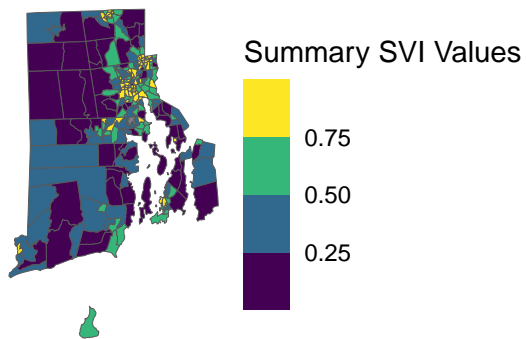
Socioeconomic Status



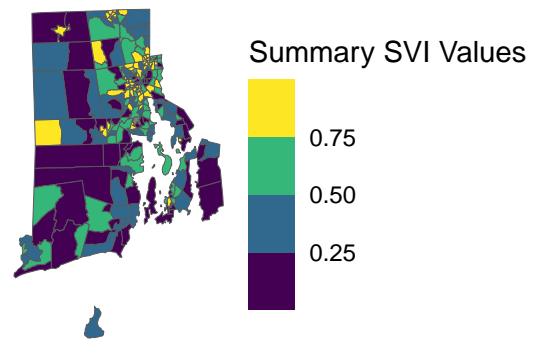
Household Characteristics



Racial & Ethnic Minority Status



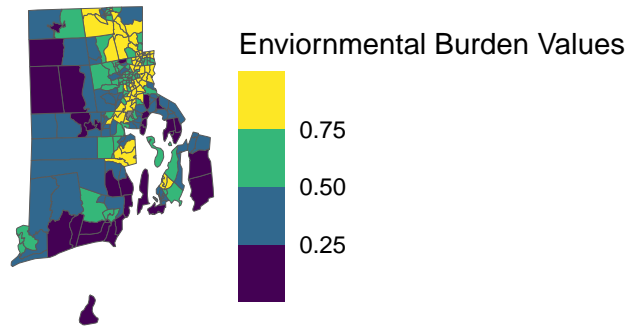
Housing Type & Transportation



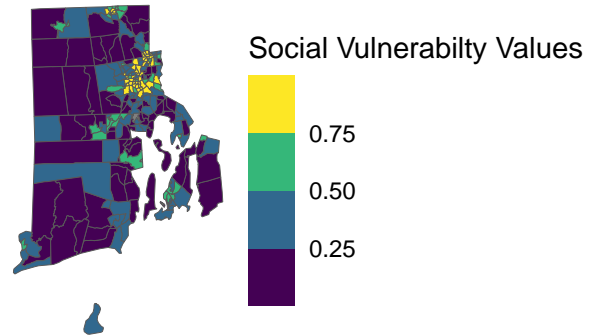
The EJI contains 3 themes, and the distribution of those themes are shown below. Quantiles of these values will be made available upon request.

Maps of Environmental Justice Index Themes, 2022

Environmental Burden



Social Vulnerability



Health Vulnerability

