1 Supplemental Material

1.1 Methods

Self Organizing Maps (SOMs): A SOM uses the euclidean distance between an observation (data) and the each node (in the SOM), and maps the SOM to fit the respective data set. Since SOM uses competitive learning, an individual node is initiated at current iteration, i, in which the data is presented to the network, thus the node with the smallest Euclidean distance is chosen as the Best Matching Unit (BMU). In this study, the number of iterations, n, is set to $10,000$. whereas the number of nodes differ per census region, using a technique suggested by [1] in which the number of nodes is equal to heuristic formula: $5 \cdot \sqrt{n_{observations}}$. The number of nodes, or map size, was adjusted at times. Given the SOM had missing nodes in these instances, the number of nodes was reduced, this being the most randomized step in the SOM process. To calculate the neighborhood radius, the radius at which each node shares information with its neighbors is calculated in Eq. 1.

$$nr(t) = nr_0(t)e^{-(\frac{t}{\lambda})} \tag{1}$$

The learning rate for each epoch is provided in Eq. 2.

$$\sigma(t) = \sigma_0(t)e^{-(\frac{t}{\lambda})} \tag{2}$$

The best matching unit is found using Eq. 3.

$$D(w_i, w_j) = \sum (w_{i_m}, w_{j_m})^2 \tag{3}$$

Lastly, the weights of w_k are adjusted for all w_k such that Distance(winner, w_k) $< nr(t)$), the weights are calculated in 4. This allows the nodes weight vector, and adjacent nodes weight vectors within a given radius to be updated to reflect the given data point.

$$w(t+1) = w(t) + \alpha(t)\sigma(t)(x - w(t)) \tag{4}$$

Where: $\lambda = \frac{\text{Number of iterations}}{\text{Maximum radius of Grid}}$

nr(t) = neighborhood radius

$\sigma(t)$ = learning rate

D(w_i, w_j) = Distance between Neuron i and j

$\alpha(t) = e^{-\frac{\text{Distance from BMU}^2}{2 \cdot nr(t)^2}}$

w = weight or node.

Kruskal–Wallis Test : The Kruskal-Wallis test is a nonparametric equivalent to a one-way Analysis of Variance (ANOVA), and is used in this study since it does not assume a normal distribution. The null hypothesis for a Kruskal-Wallis test is that the mean ranks of the groups, in this case the SOM nodes, are equal. The Kruskal–Wallis Test begins by ranking all data, 1 through N despite what group, or SOM node, the data value is assigned to. The statistic is then computed using eq. 5.

$$H = (N-1)\frac{\sum_{i=1}^{g} n_i (\bar{r}_i - \bar{r})^2}{\sum_{i=1}^{g} \sum_{j=1}^{n_i} (\bar{r_{ij}} - \bar{r})^2} \tag{5}$$

Where: N = Total Number of observations

g = The number of SOM nodes

n_i = The number of observations in group i

r_{ij} = The rank among the total number of observations j from group i

$\bar{r}_i$ = The average rank of all observations in group i i.e. $\frac{\sum_{j=1}^{n_i} \bar{r_{ij}}}{n_i}$

$\bar{r}$ = The average of all r_{ij} i.e. $\frac{1}{2}(N+1)$

1.2 Data Description and Processing

1

Table 1: Energy Burden Indicator Data Descriptions

Data Label	Data Description	Data Source
PRED0_E	Estimated number of individuals with zero risk factors	Community Resilience for Equity and Disasters
PRED12_E	Estimated number of individuals with one-two risk factors	Community Resilience for Equity and Disasters
PRED3_E	Estimated number of individuals with three plus risk factors	Community Resilience for Equity and Disasters
ACSTOTPOP	Total Population Count	EJ Screen
ACSIPOVBAS	Population for whom poverty status is determined	EJ Screen
ACSTOTHH	Households (for linguistic isolation)	EJ Screen
ACSTOTHU	Housing units (for % built pre-1960)	EJ Screen
MINORPOP	Count of people of color individuals	EJ Screen
LOWINCOME	Count of low-income individuals	EJ Screen
LESSHS	Count of individuals age 25 or over with less than high school degree	EJ Screen
LINGISO	Count of households in linguistic isolation	EJ Screen
UNDER5	Count of individuals under age 5	EJ Screen
OVER64	Count of individuals over age 64	EJ Screen
PRE1960	Count of housing units built before 1960	EJ Screen
DSLPM	Diesel particulate matter level in air	EJ Screen
CANCER	Air toxics cancer risk	EJ Screen
RESP	Air toxics respiratory hazard index	EJ Screen
PTRAF	Traffic proximity and volume	EJ Screen
PWDIS	Indicator for major direct dischargers to water	EJ Screen
PNPL	Proximity to National Priorities List (NPL) sites	EJ Screen
PRMP	Proximity to Risk Management Plan (RMP) facilities	EJ Screen
PTSDF	Proximity to Treatment Storage and Disposal (TSDF) facilities	EJ Screen
OZONE	Ozone level in air	EJ Screen
PM25	PM2.5 level in air	EJ Screen
Lat, Lon	Latitude and Longitude	NOAA
Temperature	Average Daily Temperature - July	NOAA
Air Conditioning Type	Air Conditioning type in home (4 categorical variables: Central AC, Heat Pump, Room AC, No AC)	ResStock
Building Geometry Type (RECS)	Type of Home (5 categorical variables; mobile home, single family attached, single family detached, multifamily 2-4 units, multifamily 5+ unit)	ResStock
Building Bedrooms	Number of bedrooms in home (5 categorical variables: 1-5 bedrooms)	ResStock
Power Outages	Power Outage Variables (Customers Impacted, Power Outage Duration (Minutes), Average Outage Occurrence.	Power Outages
Energy Burden	Energy Burden ($energy bill/$ income)	Low Income Energy Affordability Tool

1.3 Extended Results

1.3.1 West Region

Here the distribution of each indicator studied in respect to the node the data belonged in. The low energy burden nodes are purple, the medium energy burden nodes are white, and the high energy burden nodes are red.
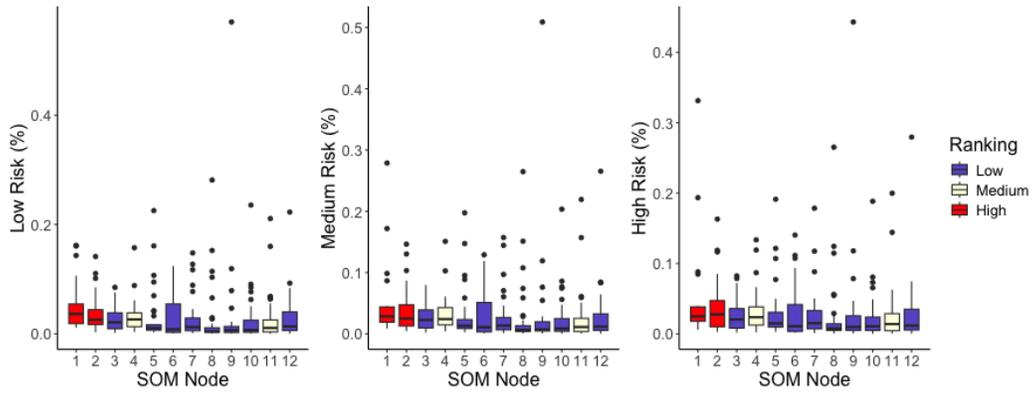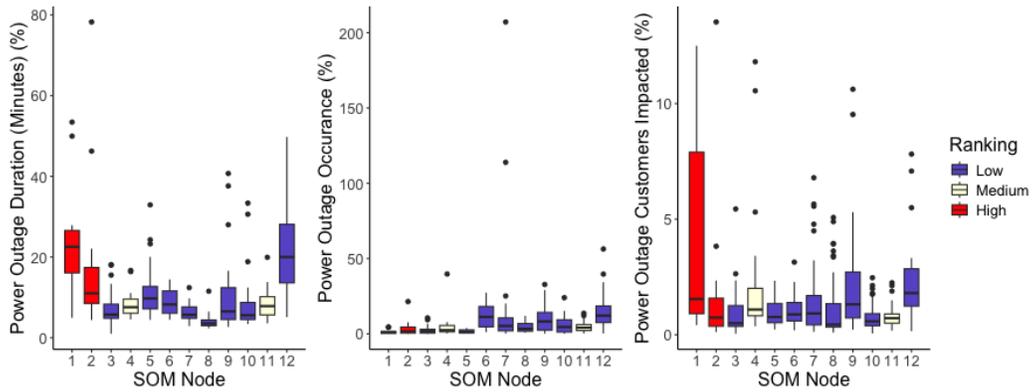
Figure 1: Distribution of Resilience Metrics

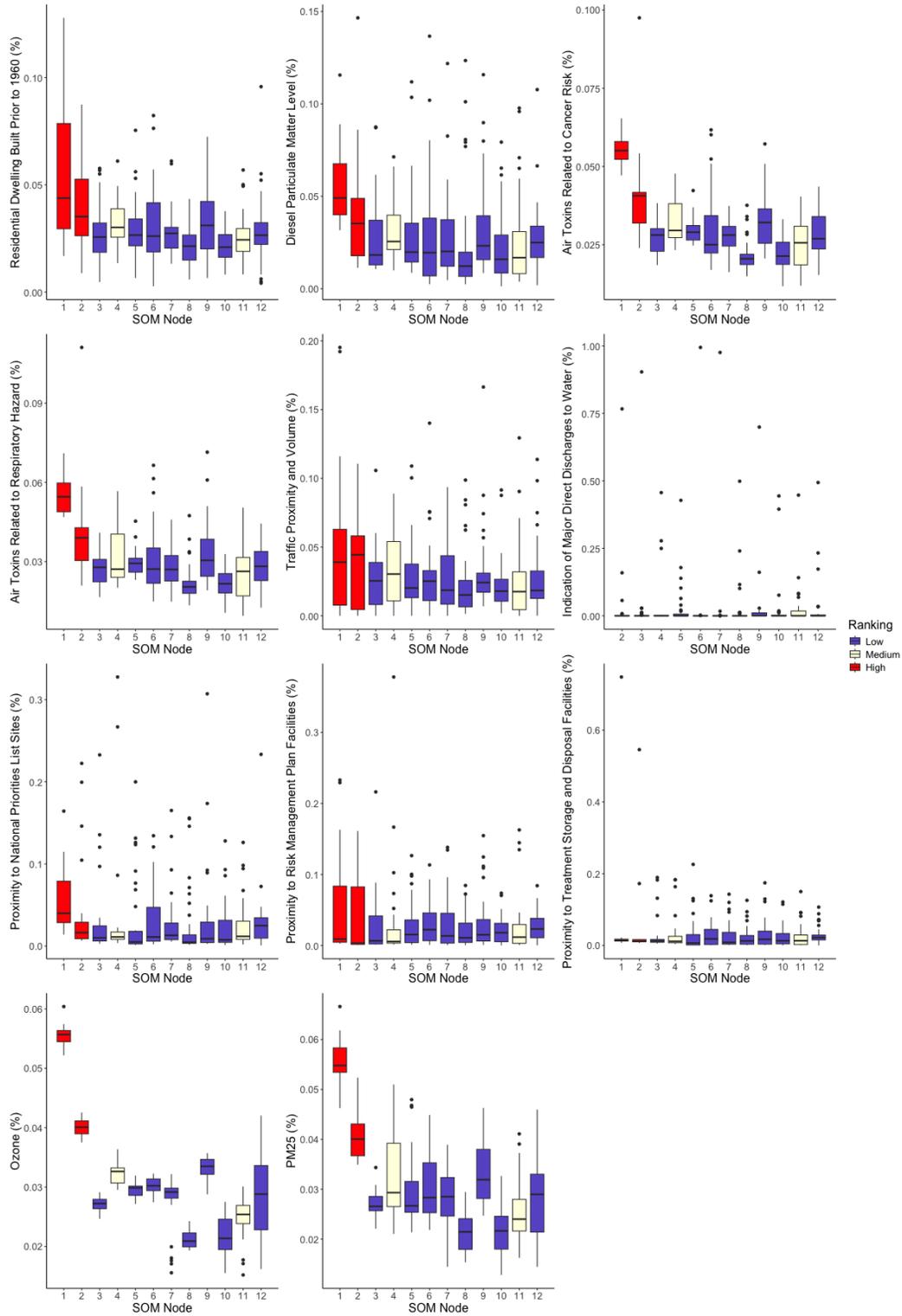Figure 2: Distribution of Power Outage Metrics
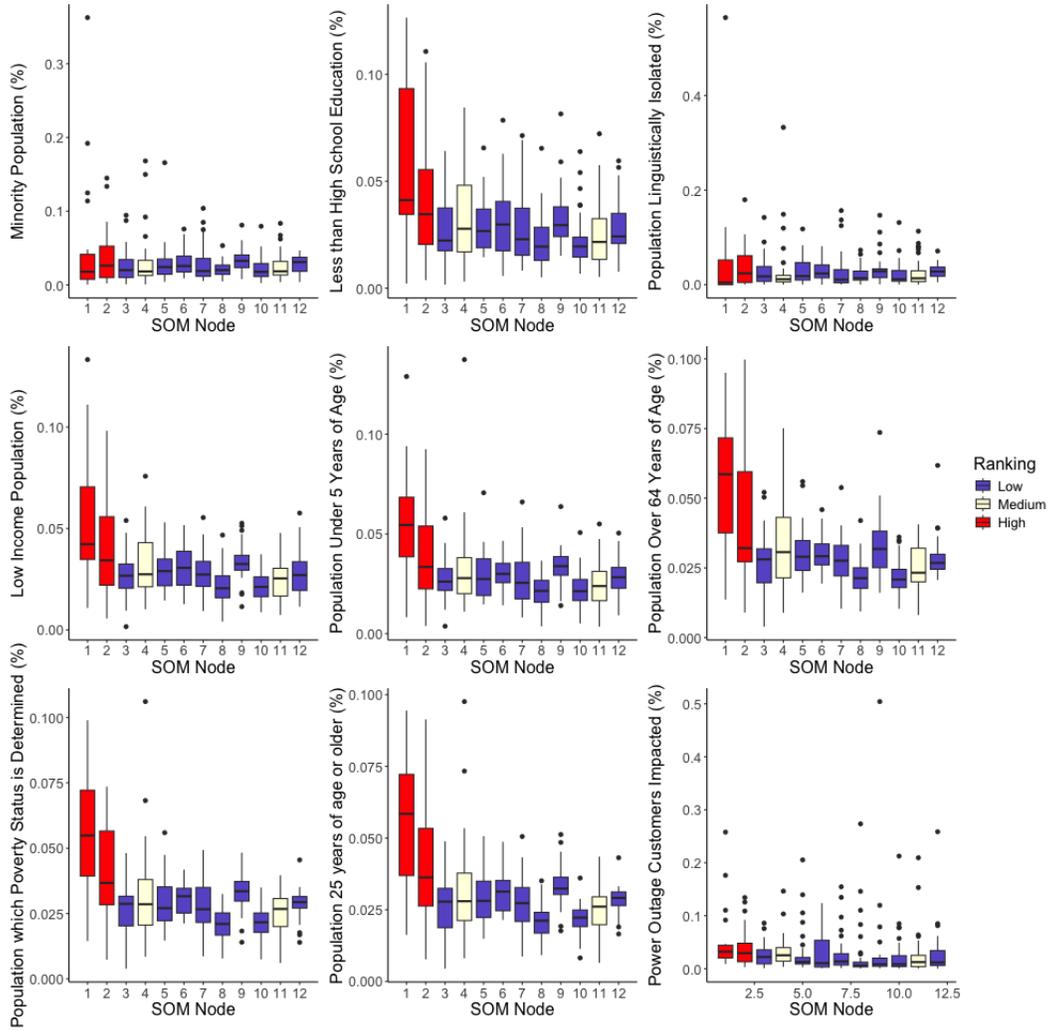
Figure 3: Distribution of Environmental Justice Metrics
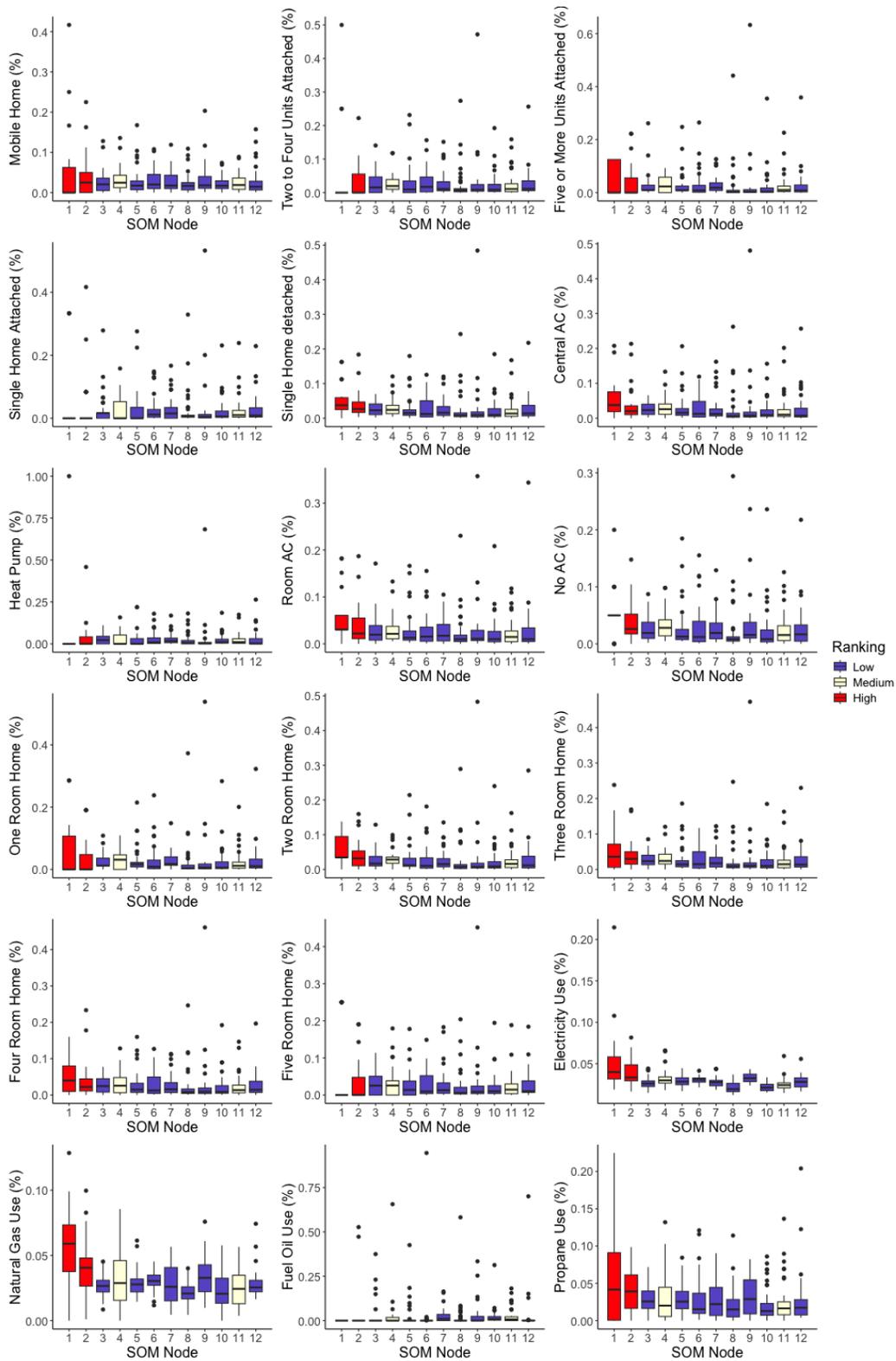
Figure 4: Distribution of Socioeconomic Metrics

Figure 5: Distribution of Residential Building Metrics

41 Note that a p-value of less than 0.05 ($p > 0.05$) is considered to be statistically significant. Each
42 indicator except mobile homes, room ac, 5 bedroom home, propane consumption are considered
43 significant.

Table 2: West Region Kruskal–Wallis Test P-Values

| Indicator	Description	SOM West Value
Indicator 1	Community Resilience: Low Risk	<2.2E-16
Indicator 2	Community Resilience: Moderate Risk	<2.2E-16
Indicator 3	Community Resilience: High Risk	<2.2E-16
Indicator 4	County Population	<2.2E-16
Indicator 5	Population for whom poverty status is determined	<2.2E-16
Indicator 6	Population age 25 and above	<2.2E-16
Indicator 7	People of color	<2.2E-16
Indicator 8	Low-income individuals	9.13E-14
Indicator 9	Age 25 or over with less than a high school degree	<2.2E-16
Indicator 10	Households in linguistic isolation	<2.2E-16
Indicator 11	Individuals under age five	<2.2E-16
Indicator 12	Individuals over age 64	1.88E-13
Indicator 13	Housing units built before 1960	2.40E-08
Indicator 14	Diesel particulate matter level in air	<2.2E-16
Indicator 15	Air toxics cancer risk	<2.2E-16
Indicator 16	Air toxics respiratory hazard index	<2.2E-16
Indicator 17	Traffic proximity and volume	<2.2E-16
Indicator 18	Indicator for major direct dischargers to water	<2.2E-16
Indicator 19	Proximity to National Priorities List sites	1.75E-10
Indicator 20	Proximity to Risk Management Plan facilities	4.47E-09
Indicator 21	Proximity to Treatment Storage and Disposal facilities	2.20E-16
Indicator 22	Ozone level in air	<2.2E-16
Indicator 23	PM2.5 level in air	<2.2E-16
Indicator 24	Outdoor Temperature	2.40E-11
Indicator 25	Mobile Home	2.59E-01
Indicator 26	Multi-Family with 2 - 4 Units	2.11E-02
Indicator 27	Multi-Family with 5+ Units	2.76E-03
Indicator 28	Single-Family Attached	1.23E-02
Indicator 29	Single-Family Detached	1.62E-05
Indicator 30	Central AC	1.04E-03
Indicator 31	Heat Pump	1.77E-04
Indicator 32	None	4.92E-05
Indicator 33	Room AC	7.31E-02
Indicator 34	One Bedroom Home	1.74E-03
Indicator 35	Two Bedroom Home	1.11E-04
Indicator 36	Three Bedroom Home	1.92E-03
Indicator 37	Four bedroom Home	2.40E-02
Indicator 38	Five+ bedroom Home	2.35E-01
Indicator 39	Electricity Consumption	2.20E-16
Indicator 40	Fuel Oil Consumption	1.53E-10
Indicator 41	Natural Gas Consumption	1.37E-07
Indicator 42	Propane Consumption	1.51E-01
Indicator 43	Power Outage Duration	<2.2e-16
Indicator 44	Power Outage Occurrence	2.28E-16
Indicator 45	Power Outage: Customers Impacted	1.27E-07

1.3.2 Northeast Region
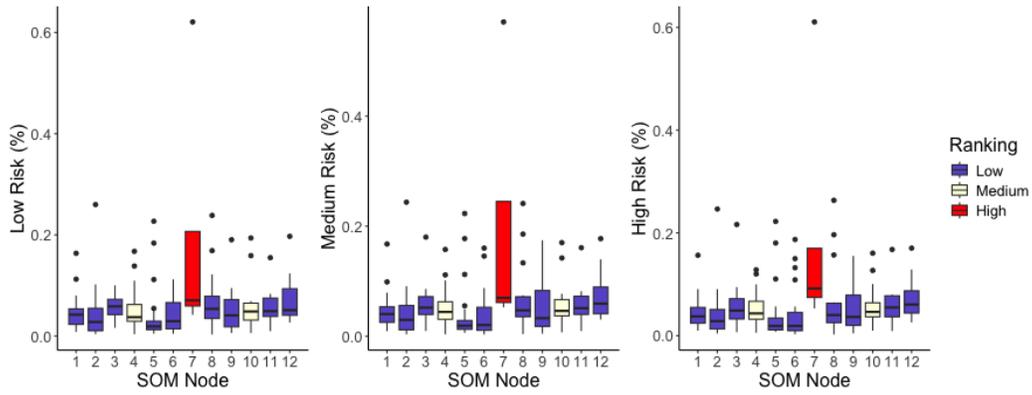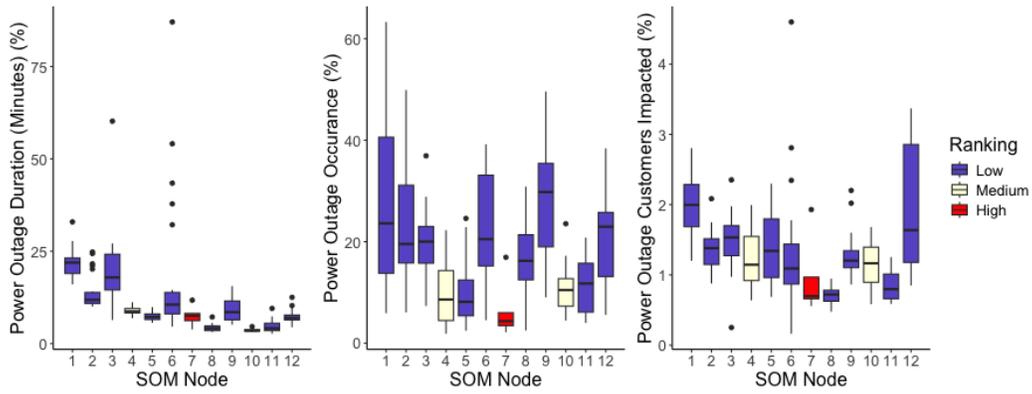

Figure 6: Distribution of Resilience Metrics

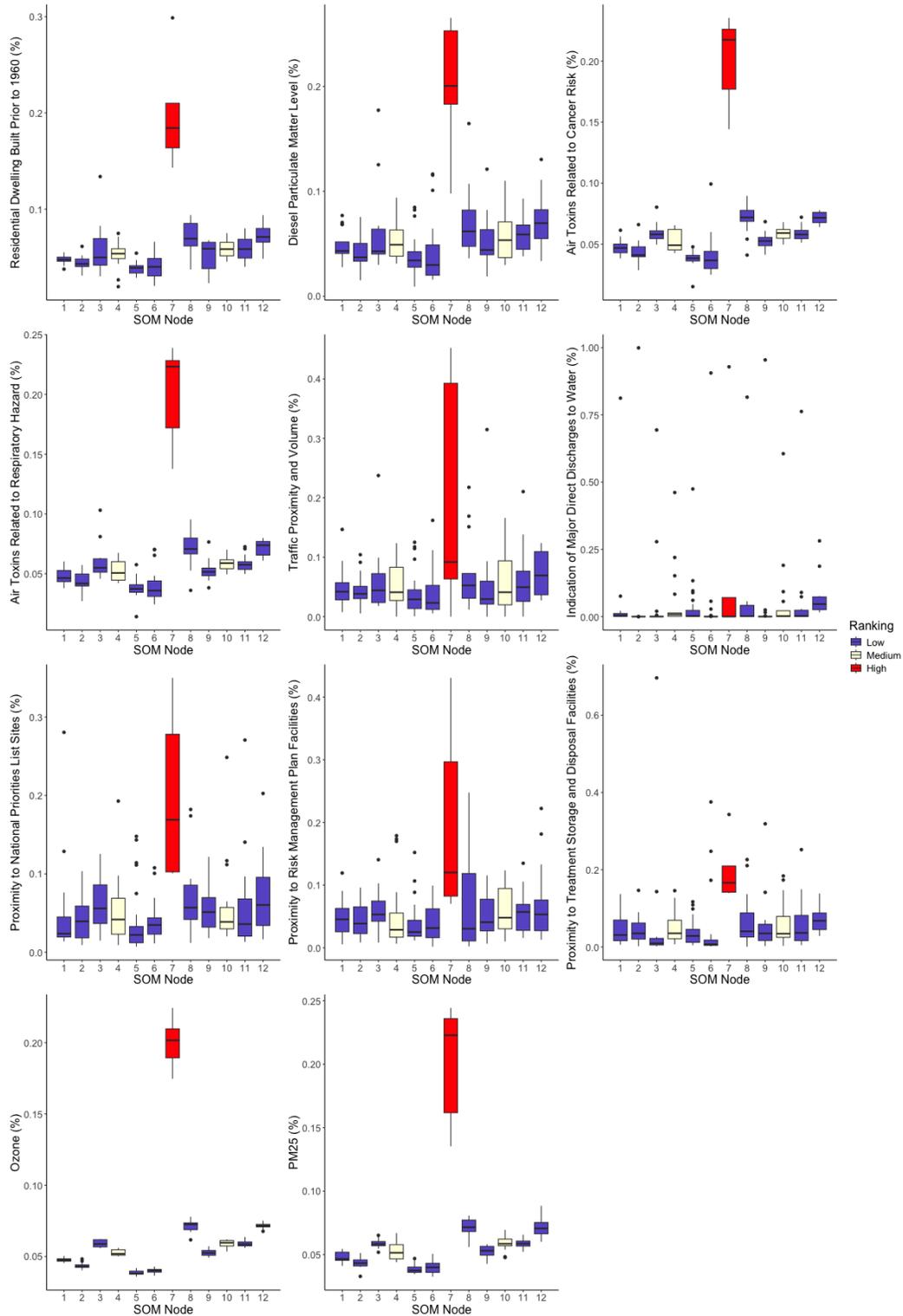Figure 7: Distribution of Power Outage Metrics

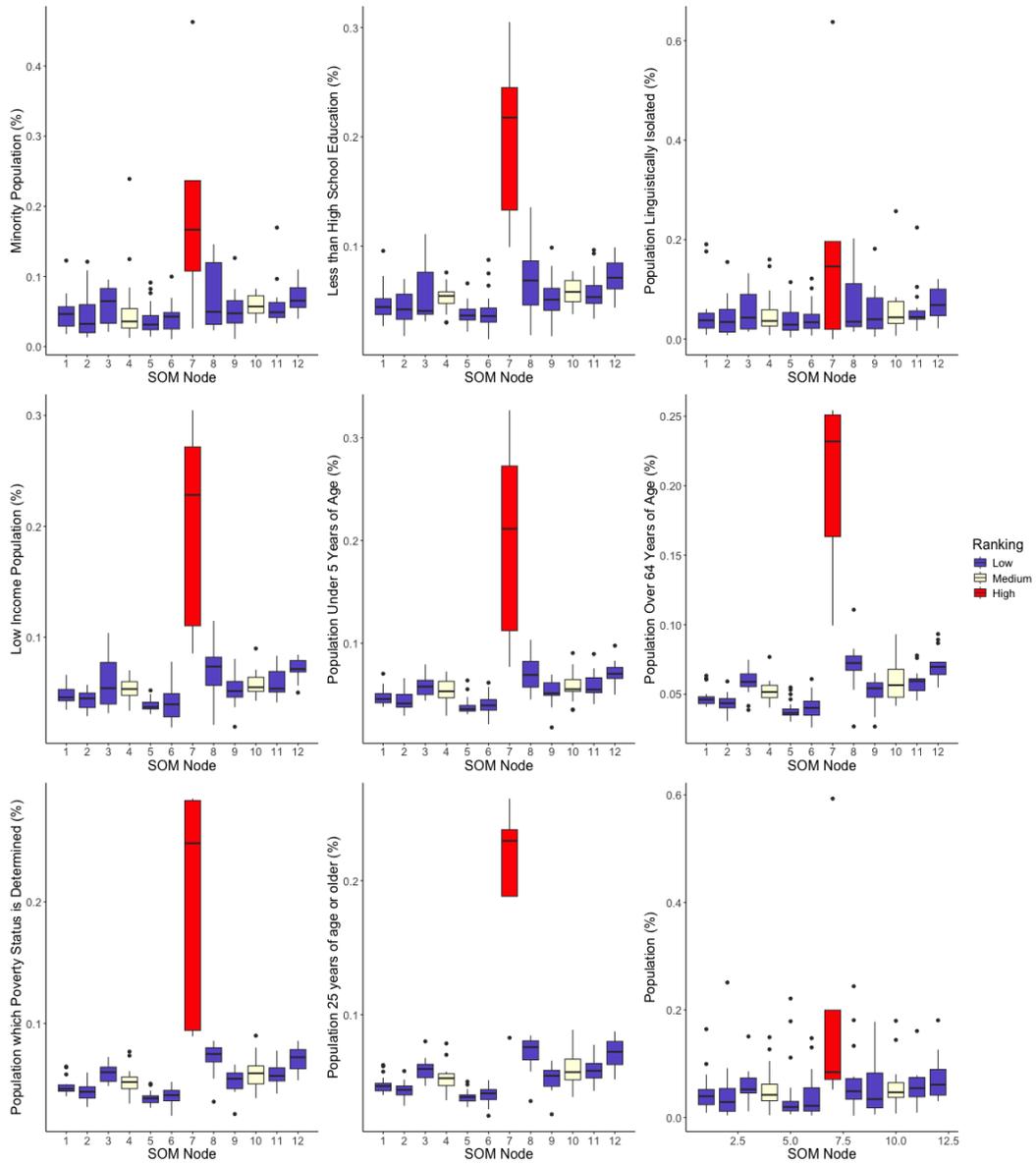Figure 8: Distribution of Environmental Justice Metrics

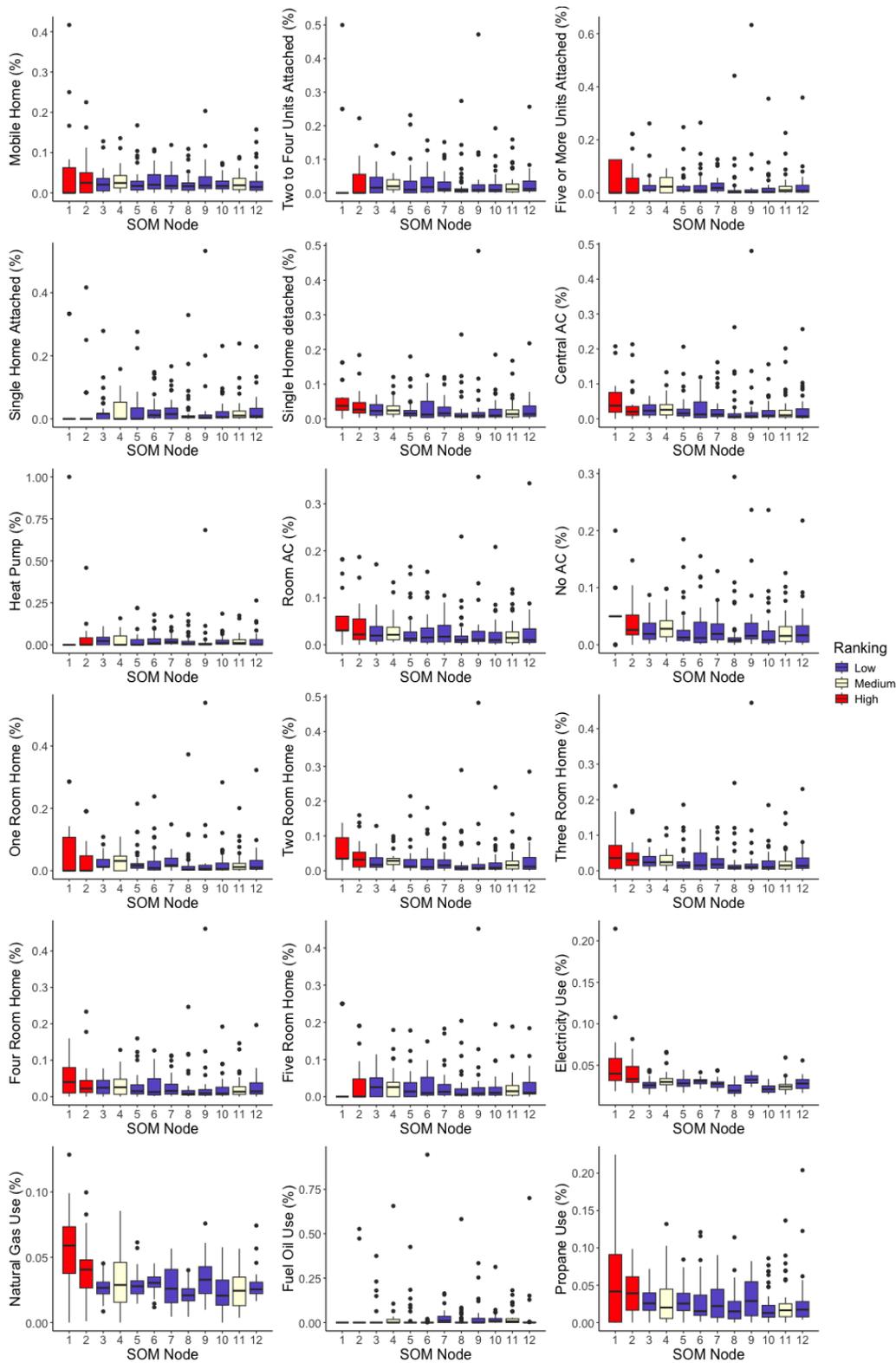Figure 9: Distribution of Socioeconomic Metrics

Figure 10: Distribution of Residential Building Metrics

Table 3: Northeast Region Kruskal–Wallis Test P-Values

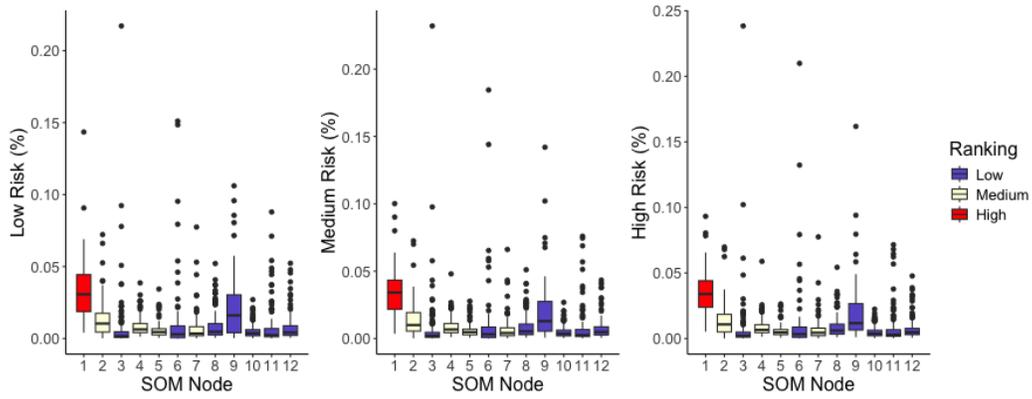| Feature	Description	SOM Northeast Value
Feature 1	Community Resilience: Low Risk	<2.2E-16
Feature 2	Community Resilience: Moderate Risk	<2.2E-16
Feature 3	Community Resilience: High Risk	<2.2E-16
Feature 4	County Population	<2.2E-16
Feature 5	Population for whom poverty status is determined	1.30E-10
Feature 6	Population age 25 and above	4.58E-08
Feature 7	People of color	<2.2E-16
Feature 8	Low-income individuals	4.77E-07
Feature 9	Age 25 or over with less than a high school degree	1.61E-04
Feature 10	Households in linguistic isolation	<2.2E-16
Feature 11	Individuals under age five	2.10E-15
Feature 12	Individuals over age 64	1.53E-02
Feature 13	Housing units built before 1960	1.67E-03
Feature 14	Diesel particulate matter level in air	<2.2E-16
Feature 15	Air toxics cancer risk	<2.2E-16
Feature 16	Air toxics respiratory hazard index	<2.2E-16
Feature 17	Traffic proximity and volume	<2.2E-16
Feature 18	Indicator for major direct dischargers to water	6.38E-13
Feature 19	Proximity to National Priorities List sites	5.26E-15
Feature 20	Proximity to Risk Management Plan facilities	5.82E-12
Feature 21	Proximity to Treatment Storage and Disposal facilities	2.20E-16
Feature 22	Ozone level in air	<2.2E-16
Feature 23	PM2.5 level in air	<2.2E-16
Feature 24	Outdoor Temperature	1.30E-09
Feature 25	Mobile Home	4.05E-02
Feature 26	Multi-Family with 2 - 4 Units	6.04E-06
Feature 27	Multi-Family with 5+ Units	8.56E-06
Feature 28	Single-Family Attached	1.57E-03
Feature 29	Single-Family Detached	1.22E-05
Feature 30	Central AC	2.22E-05
Feature 31	Heat Pump	3.96E-01
Feature 32	None	6.80E-05
Feature 33	Room AC	1.91E-05
Feature 34	One Bedroom Home	1.77E-04
Feature 35	Two Bedroom Home	4.35E-05
Feature 36	Three Bedroom Home	8.30E-06
Feature 37	Four bedroom Home	6.02E-05
Feature 38	Five+ bedroom Home	1.60E-03
Feature 39	Electricity Consumption	2.20E-16
Feature 40	Fuel Oil Consumption	1.30E-04
Feature 41	Natural Gas Consumption	5.30E-03
Feature 42	Propane Consumption	8.32E-05
Indicator 43	Power Outage Duration	< 2.2e-16
Indicator 44	Power Outage Occurrence	8.762e-14
Indicator 45	Power Outage: Customers Impacted	1.249e-14

1.3.3 South Region

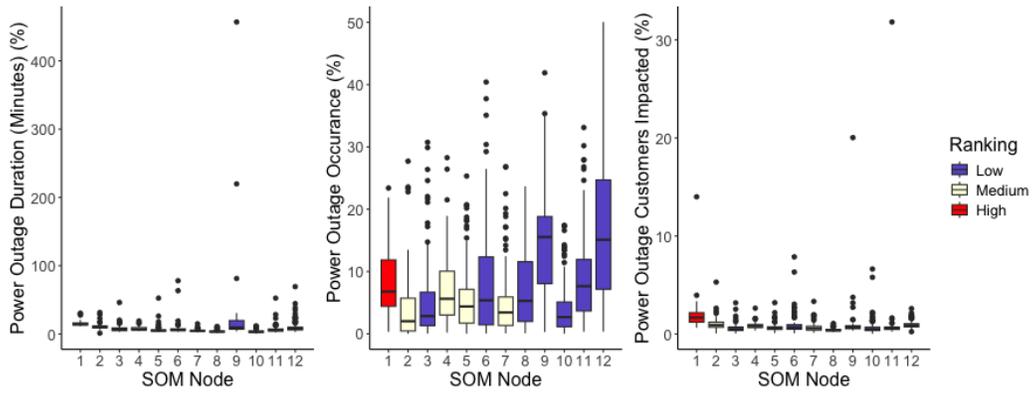Figure 11: Distribution of Resilience Metrics

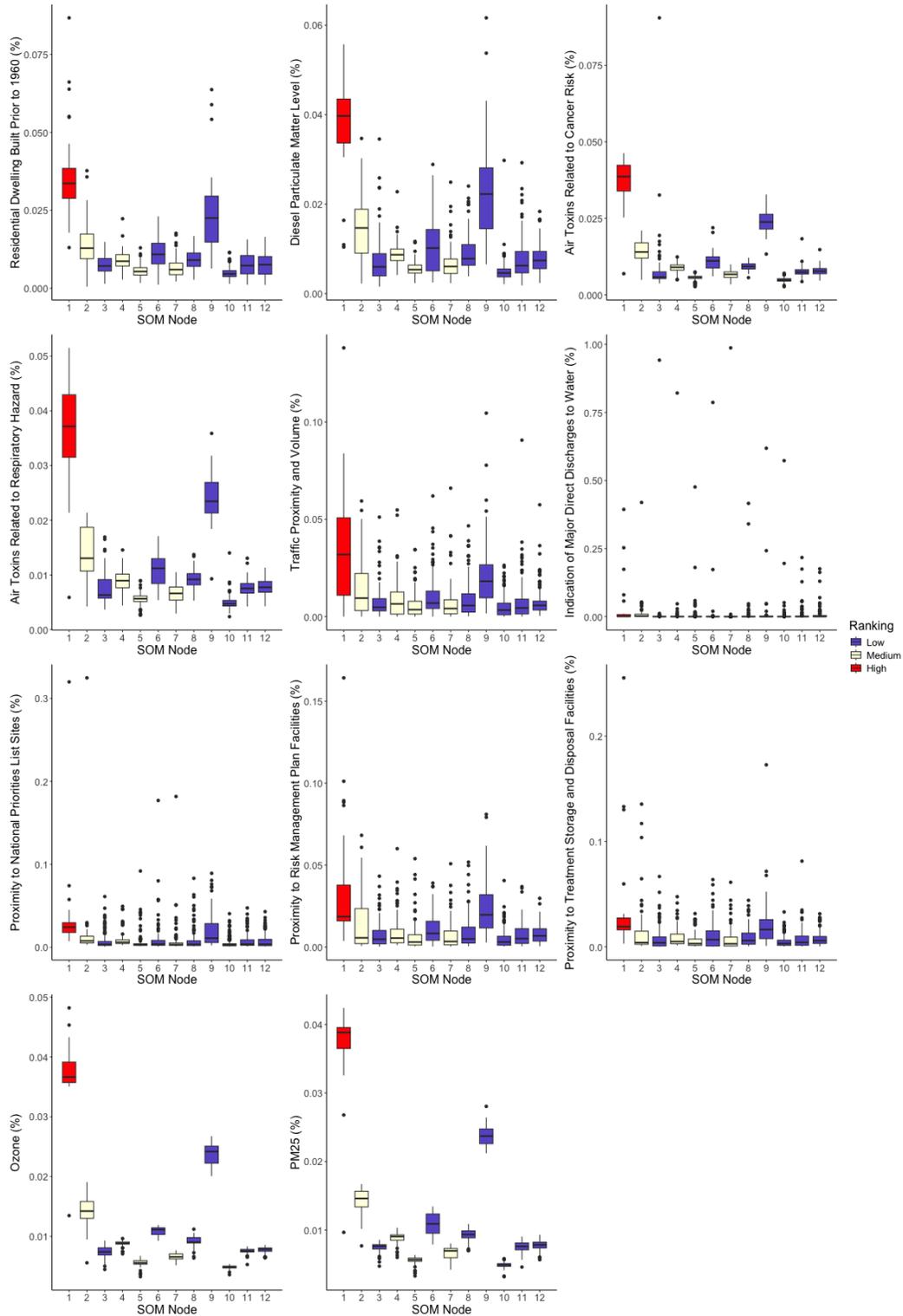Figure 12: Distribution of Power Outage Metrics

14

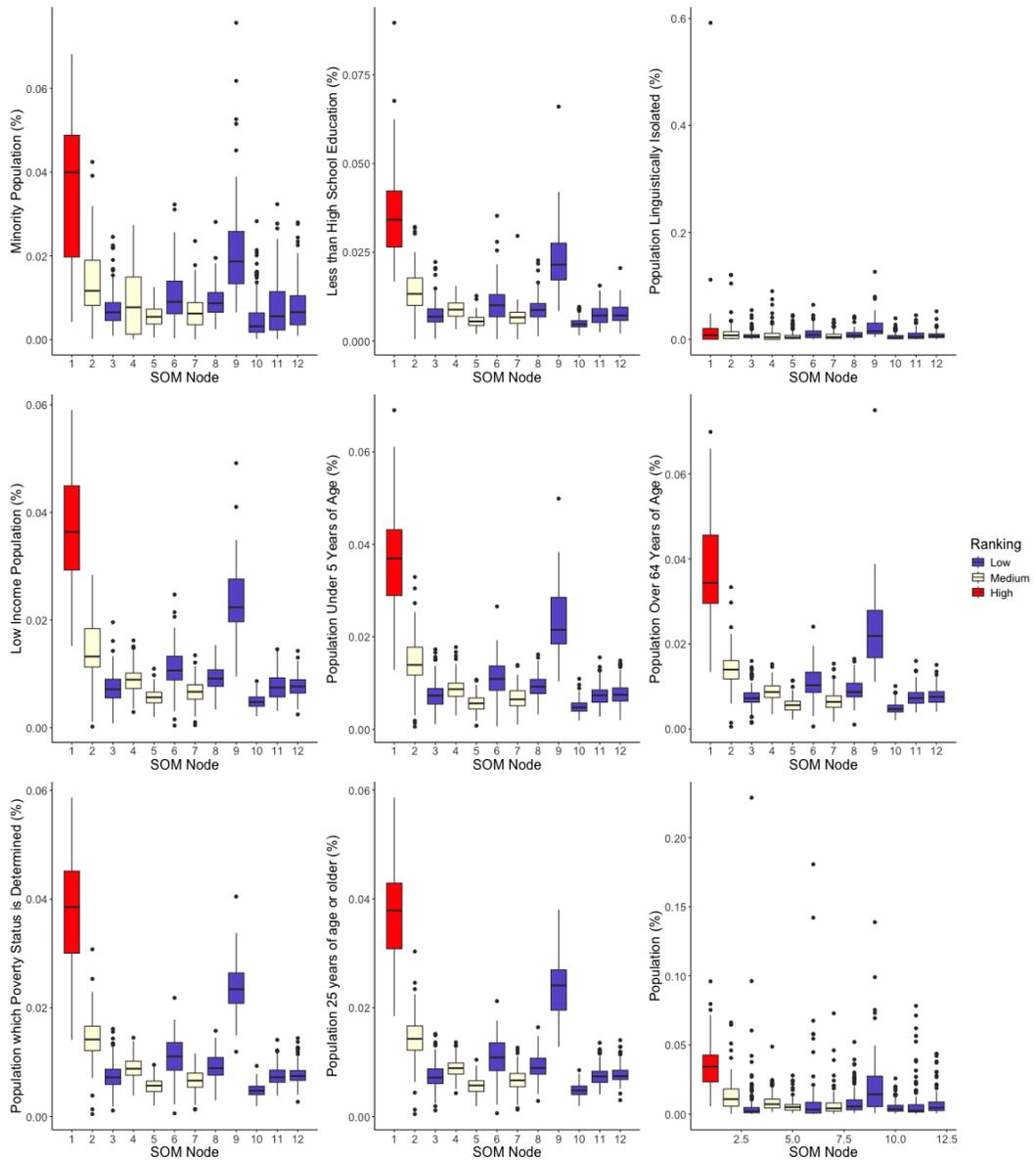Figure 13: Distribution of Environmental Justice Metrics

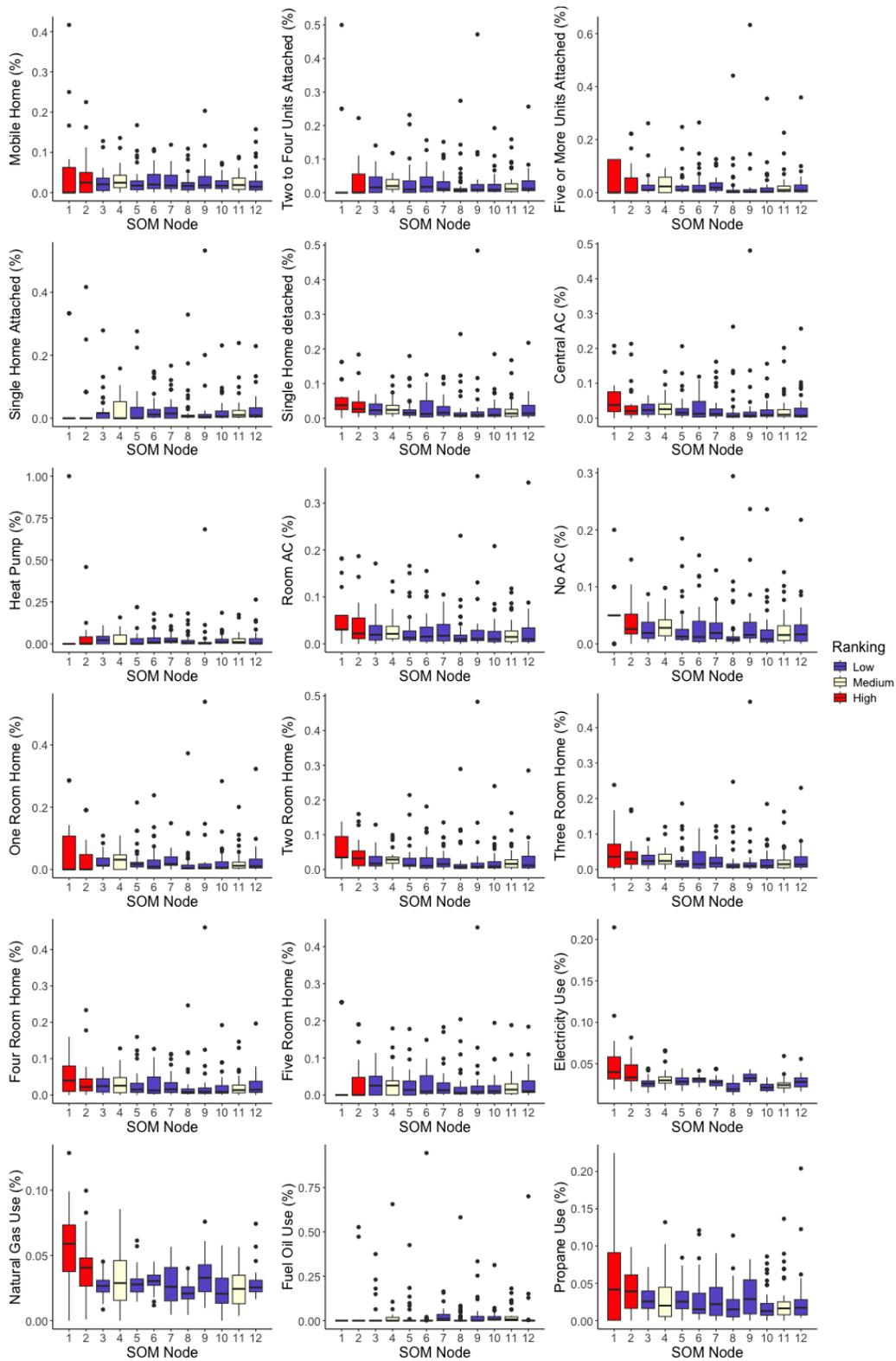Figure 14: Distribution of Socioeconomic Metrics

Figure 15: Distribution of Residential Building Metrics

Table 4: South Region Kruskal–Wallis Test P-Values

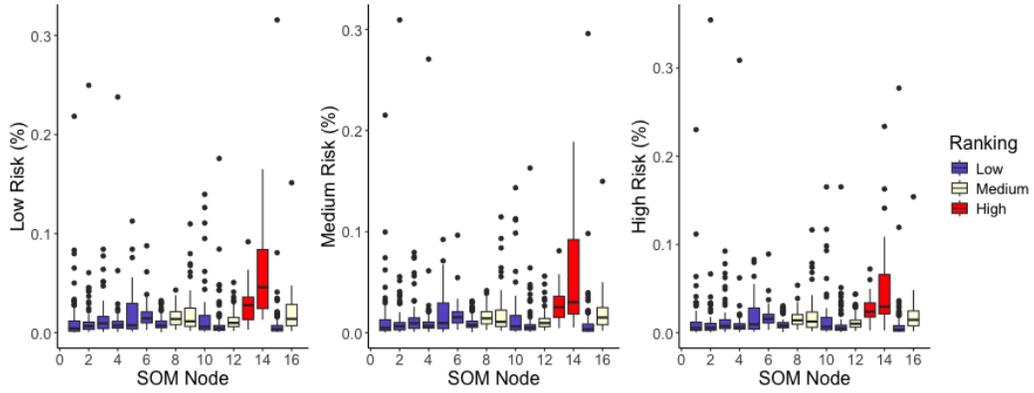| Feature	Description	SOM South Value
Feature 1	Community Resilience: Low Risk	<2.2E-16
Feature 2	Community Resilience: Moderate Risk	<2.2E-16
Feature 3	Community Resilience: High Risk	<2.2E-16
Feature 4	County Population	<2.2E-16
Feature 5	Population for whom poverty status is determined	<2.2E-16
Feature 6	Population age 25 and above	<2.2E-16
Feature 7	People of color	<2.2E-16
Feature 8	Low-income individuals	<2.2E-16
Feature 9	Age 25 or over with less than a high school degree	<2.2E-16
Feature 10	Households in linguistic isolation	<2.2E-16
Feature 11	Individuals under age five	<2.2E-16
Feature 12	Individuals over age 64	<2.2E-16
Feature 13	Housing units built before 1960	<2.2E-16
Feature 14	Diesel particulate matter level in air	<2.2E-16
Feature 15	Air toxics cancer risk	<2.2E-16
Feature 16	Air toxics respiratory hazard index	<2.2E-16
Feature 17	Traffic proximity and volume	<2.2E-16
Feature 18	Indicator for major direct dischargers to water	<2.2E-16
Feature 19	Proximity to National Priorities List sites	<2.2E-16
Feature 20	Proximity to Risk Management Plan facilities	<2.2E-16
Feature 21	Proximity to Treatment Storage and Disposal facilities	<2.2E-16
Feature 22	Ozone level in air	<2.2E-16
Feature 23	PM2.5 level in air	<2.2E-16
Feature 24	Outdoor Temperature	<2.2E-17
Feature 25	Mobile Home	2.20E-16
Feature 26	Multi-Family with 2 - 4 Units	2.39E-09
Feature 27	Multi-Family with 5+ Units	2.20E-16
Feature 28	Single-Family Attached	2.59E-12
Feature 29	Single-Family Detached	2.20E-16
Feature 30	Central AC	2.20E-16
Feature 31	Heat Pump	2.20E-16
Feature 32	None	6.86E-12
Feature 33	Room AC	2.20E-16
Feature 34	One Bedroom Home	2.20E-16
Feature 35	Two Bedroom Home	2.20E-16
Feature 36	Three Bedroom Home	2.20E-16
Feature 37	Four bedroom Home	2.20E-16
Feature 38	Five+ bedroom Home	2.20E-16
Feature 39	Electricity Consumption	2.20E-16
Feature 40	Fuel Oil Consumption	2.20E-16
Feature 41	Natural Gas Consumption	2.20E-16
Feature 42	Propane Consumption	2.20E-16
Indicator 43	Power Outage Duration	2.20E-16
Indicator 44	Power Outage Occurrence	2.20E-16
Indicator 45	Power Outage: Customers Impacted	2.20E-16

1.3.4 Midwest Region
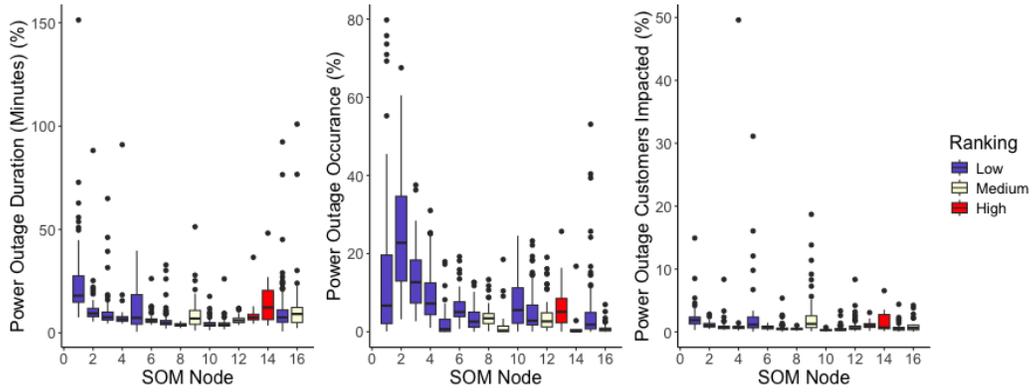

Figure 16: Distribution of Resilience Metrics

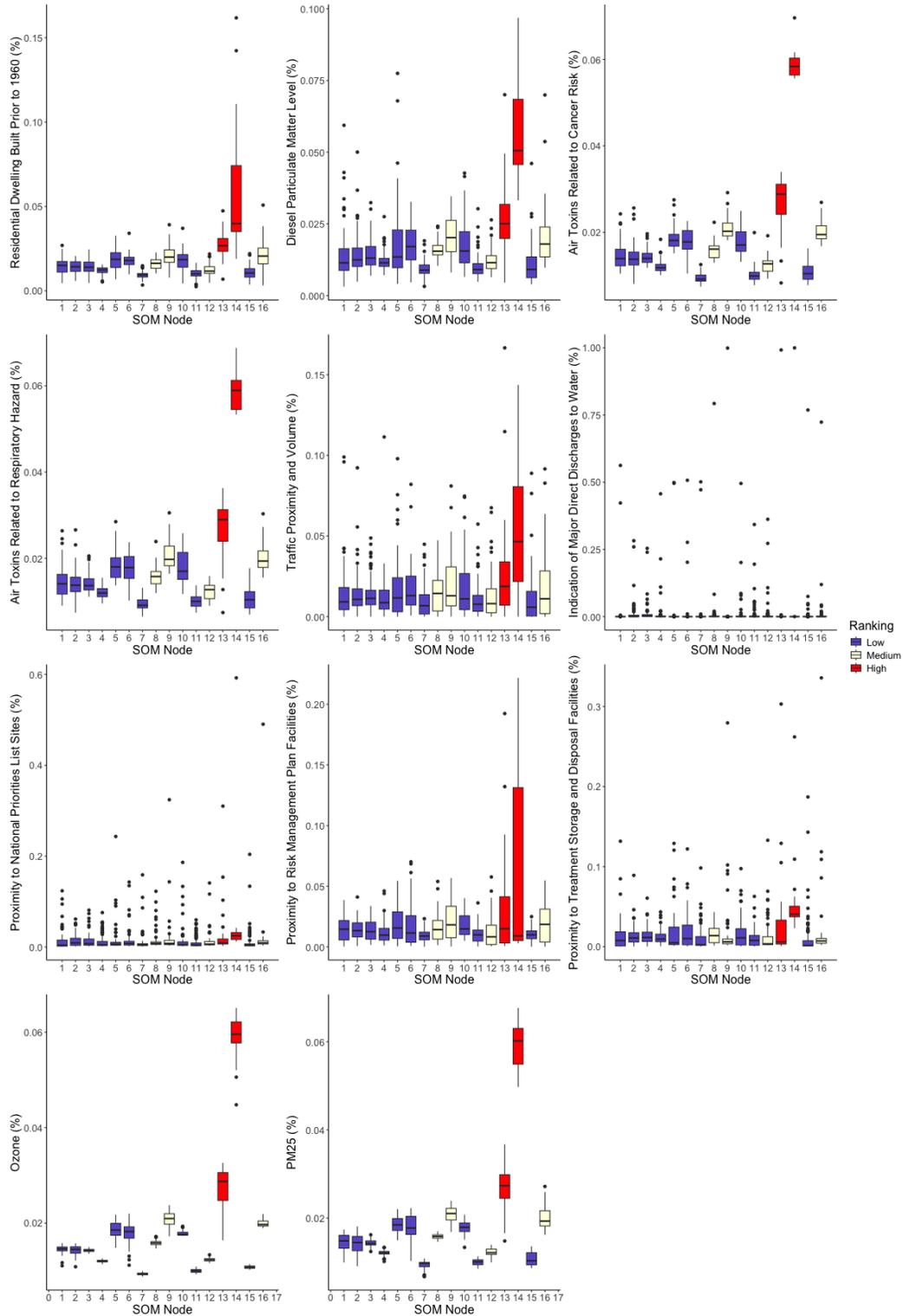

Figure 17: Distribution of Power Outage Metrics

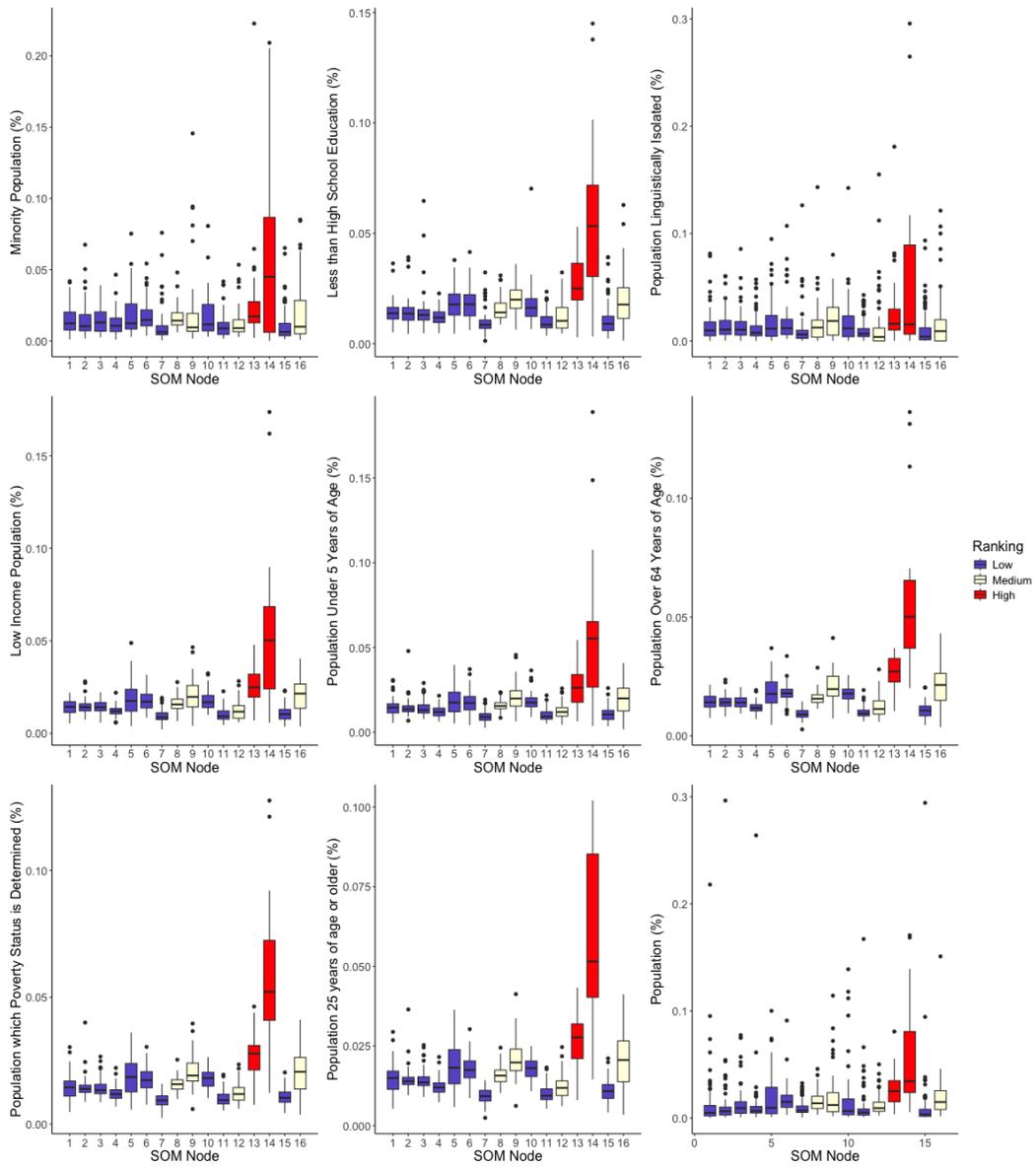Figure 18: Distribution of Environmental Justice Metrics

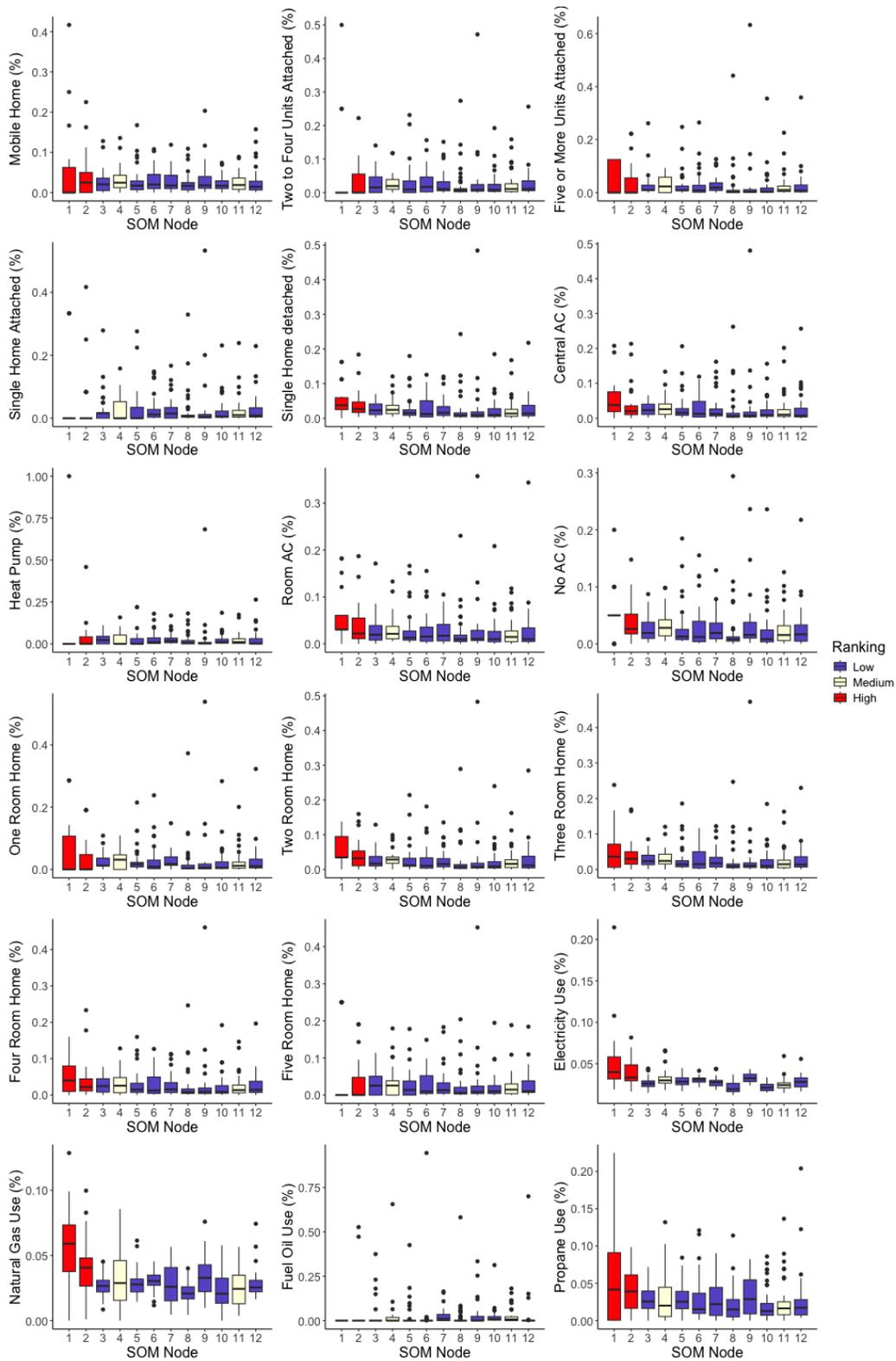Figure 19: Distribution of Socioeconomic Metrics

Figure 20: Distribution of Residential Building Metrics

Table 5: Midwest Region Kruskal–Wallis Test P-Values

Feature	Description	SOM Midwest Value
Feature 1	Community Resilience: Low Risk	<2.2E-16
Feature 2	Community Resilience: Moderate Risk	<2.2E-16
Feature 3	Community Resilience: High Risk	<2.2E-16
Feature 4	County Population	<2.2E-16
Feature 5	Population for whom poverty status is determined	<2.2E-16
Feature 6	Population age 25 and above	<2.2E-16
Feature 7	People of color	<2.2E-16
Feature 8	Low-income individuals	<2.2E-16
Feature 9	Age 25 or over with less than a high school degree	<2.2E-16
Feature 10	Households in linguistic isolation	<2.2E-16
Feature 11	Individuals under age five	<2.2E-16
Feature 12	Individuals over age 64	<2.2E-16
Feature 13	Housing units built before 1960	<2.2E-16
Feature 14	Diesel particulate matter level in air	<2.2E-16
Feature 15	Air toxics cancer risk	<2.2E-16
Feature 16	Air toxics respiratory hazard index	<2.2E-16
Feature 17	Traffic proximity and volume	<2.2E-16
Feature 18	Indicator for major direct dischargers to water	<2.2E-16
Feature 19	Proximity to National Priorities List sites	<2.2E-16
Feature 20	Proximity to Risk Management Plan facilities	<2.2E-16
Feature 21	Proximity to Treatment Storage and Disposal facilities	<2.2E-16
Feature 22	Ozone level in air	<2.2E-16
Feature 23	PM2.5 level in air	<2.2E-16
Feature 24	Outdoor Temperature	<2.2E-17
Feature 25	Mobile Home	5.80E-11
Feature 26	Multi-Family with 2 - 4 Units	2.25E-11
Feature 27	Multi-Family with 5+ Units	2.20E-16
Feature 28	Single-Family Attached	4.91E-13
Feature 29	Single-Family Detached	2.20E-16
Feature 30	Central AC	2.20E-16
Feature 31	Heat Pump	2.12E-06
Feature 32	None	2.20E-16
Feature 33	Room AC	2.20E-16
Feature 34	One Bedroom Home	5.70E-16
Feature 35	Two Bedroom Home	2.20E-16
Feature 36	Three Bedroom Home	2.20E-16
Feature 37	Four bedroom Home	2.20E-16
Feature 38	Five+ bedroom Home	2.00E-14
Feature 39	Electricity Consumption	2.20E-16
Feature 40	Fuel Oil Consumption	2.20E-16
Feature 41	Natural Gas Consumption	2.20E-16
Feature 42	Propane Consumption	2.20E-16
Indicator 43	Power Outage Duration	2.20E-16
Indicator 44	Power Outage Occurrence	2.20E-16
Indicator 45	Power Outage: Customers Impacted	2.20E-16

References

[1] J. Vesanto and E. Alhoniemi. Clustering of the self-organizing map. *IEEE Transactions on Neural Networks*, 11(3):586–600, 2000.