

Supplemental Material for

“Human Development and Controlled Substance Prescribing in Ohio Counties”

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This supplement lays out the full data used in the analysis and provides detailed instructions and code for recreating the analyses and figures using free and open-source software.

Three appendices are included here:

Appendix A. Annotated R code for Analysis and Visualization

Appendix B. Creating a Choropleth Map of HDI in Ohio Counties in QGIS (Quantum GIS 2.18.3)

Appendix C. HDI Data for Ohio Counties

Appendix A. Annotated R code for Analysis and Visualization

```
#####  
# R Program for Epi Section Collaborative Paper 1 #  
# Ross M. Kauffman #  
# June, 2019 #  
#####  
  
# This code is intended to be shared and modified  
  
#####  
# NOTE: Paths will need to be edited to match the save location of your files #  
#####  
  
#Reading in dataset  
HDIPre <- read.csv(file="C:/HDI and Opioid Prescription/HDI-Prescriptions.csv", header=TRUE,  
sep=",")  
  
#Changing font to Times New Roman  
par(family="serif")  
  
#Chart using Solarized color palette by Ethan Schoonover  
  
plot(HDIPre$AmerHDI, HDIPre$Opioids, pch=16, col="#cb4b16",  
xlim=c(3,8),ylim=c(0,100),  
xlab="American HDI", ylab="Drug prescriptions per capita")  
text(8, 45, expression("Opioids"), pos=2, col="#cb4b16")  
text(8, 42.5, expression(r^2== 0.22), pos=2, col="#cb4b16")  
points(HDIPre$AmerHDI, HDIPre$Benzodiazepines, pch=18, col="#268bd2")  
text(8, 20, expression("Benzodiazepines"), pos=2, col="#268bd2")  
text(8, 17.5, expression(r^2== 0.18), pos=2, col="#268bd2")  
points(HDIPre$AmerHDI, HDIPre$Stimulants, pch=17, col="#d33682")  
text(8, 10, expression("Stimulants"), pos=2, col="#d33682")  
text(8, 7.3, expression(r^2== 0.24), pos=2, col="#d33682")  
points(HDIPre$AmerHDI, HDIPre$Sedatives, pch=15, col="#859900")  
text(8, 3, expression("Sedatives"), pos=2, col="#859900")  
text(8, 0.3, expression(r^2== 0.01), pos=2, col="#859900")  
clip(3.32,7.55,0,100)  
abline(lm(HDIPre$Opioids~HDIPre$AmerHDI), lty=2, lwd=2, col="#cb4b16")  
abline(lm(HDIPre$Benzodiazepines~HDIPre$AmerHDI), lty=2, lwd=2, col="#268bd2")  
abline(lm(HDIPre$Stimulants~HDIPre$AmerHDI), lty=2, lwd=2, col="#d33682")  
abline(lm(HDIPre$Sedatives~HDIPre$AmerHDI), lty=2, lwd=2, col="#859900")  
  
#Saving output into a high quality PNG image  
dev.set(2)  
dev.print(png, file="C:/HDI and Opioid Prescription/Figure3.png", width=1950, height=2400,  
res=300)  
  
#Testing correlations  
cor.test(HDIPre$AmerHDI, HDIPre$Opioids)  
cor.test(HDIPre$AmerHDI, HDIPre$Benzodiazepines)  
cor.test(HDIPre$AmerHDI, HDIPre$Stimulants)  
cor.test(HDIPre$AmerHDI, HDIPre$Sedatives)  
cor.test(HDIPre$AmerHDI, HDIPre$Age)
```

Appendix B. Creating a Choropleth Map of HDI in Ohio Counties in QGIS (Quantum GIS 2.18.3)

Quantum GIS is a free and open-source geographic information system available for download at <https://www.qgis.org/en/site/>.

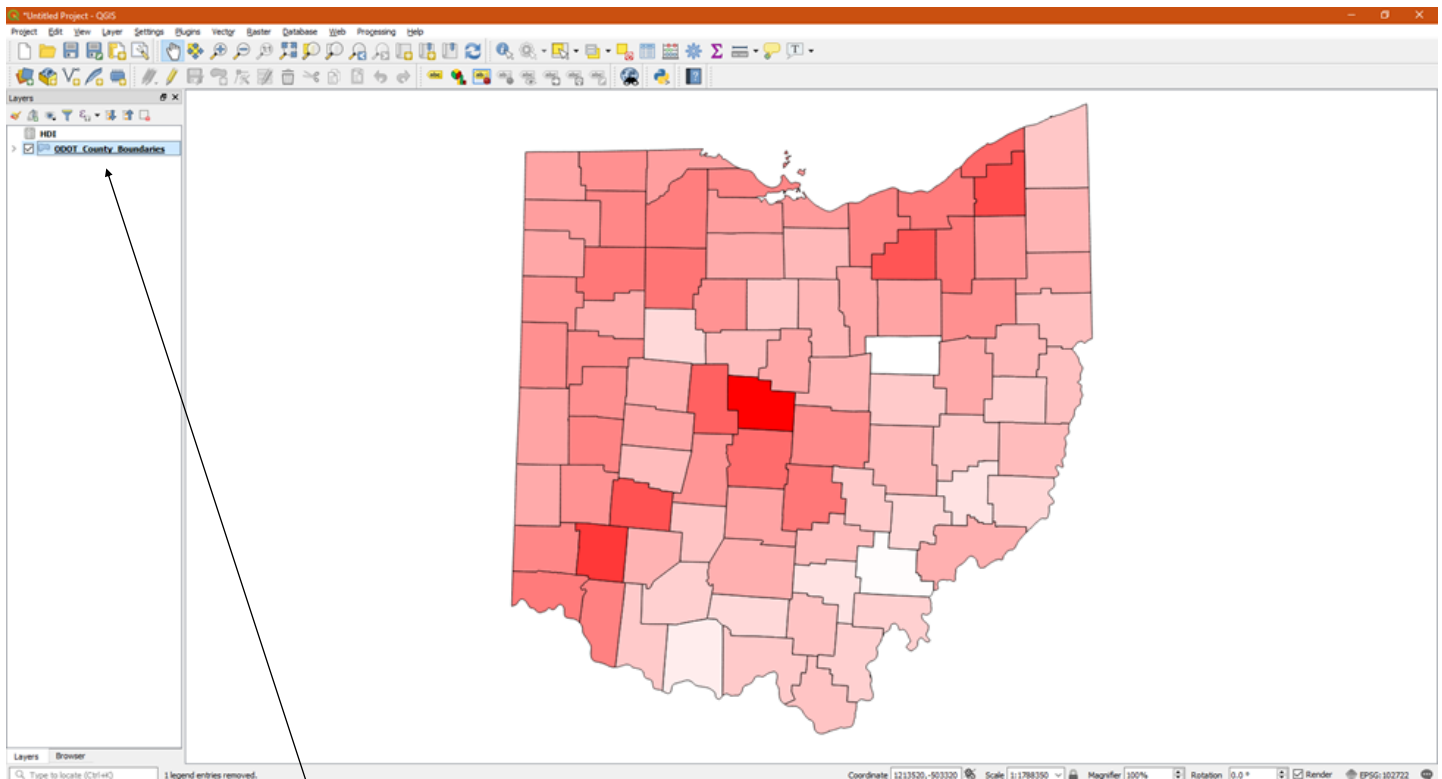
1. Open QGIS.
2. Create a new project (Project > New, or Ctrl+N).
3. Create the base map.
 - Download the shapefile of Ohio Counties from the Ohio Department of Transportation’s Transportation Information Mapping System (TIMS): <https://gis.dot.state.oh.us/tims/Data/Download> (Boundaries > County > Export Data > To Shapefile).
 - Unzip the resulting archive to a known location.
 - Open the Data Source Manager in QGIS (Layer > Add Layer > Add Vector Layer).
 - Open the shapefile.
 - Ensure the source type is set to “File.”
 - Locate the shapefile folder by clicking the “...” button to the right of the “Vector Dataset (s)” field.
 - Double click the “.shp” file (“ODOT_County_Boundaries.shp”).
 - Click the “Add” button to add the layer to your map.
 - Click the “Close” button to close the Data Source Manager window.
4. Select an appropriate coordinate reference system to minimize distortion.
 - Open the Project Properties window (Project > Properties..., or Ctrl+Shift+P).
 - Select the “CRS” tab.
 - Filter the CRS results by “Ohio” and select Authority ID EPSG:102722, the projection labelled “NAD_1983_StatePlane_Ohio_North_FIPS_3401_Feet” by clicking on the name.
 - Click the “Apply” button, then click “OK” to close the Project Properties window.
5. Import the HDI data.
 - Create an “HDI.csv” file containing the needed data (at least one column labelled “FIPS” that contains the county FIPS code and one column that contains the American HDI data labelled “HDI”). This can be done using spreadsheet software like Calc, Excel, or Sheets.
 - Open the Data Source Manager in QGIS (Layer > Add Layer > Add Delimited Text Layer).
 - Locate your “.csv” file by clicking the “...” button to the right of the “File Name” field and navigating to the appropriate location.
 - Double click on the “.csv” file to open it.
 - Under “Geometry definition” select the “No geometry (attribute only table)” option.
 - Click the “Add” button to add the layer to your map.
 - Click the “Close” button to close the Data Source Manager window.
6. Link the data layer to your base map.
 - Double click your “ODOT_County_Boundaries” layer on the layers toolbar to select the layer and open the Layer Properties window.
 - Select the “Joins” tab.

- Click the green plus button to bring up the “Add Vector Join” window.
- Make sure “Join layer” is set to “HDI.”
- Set the “Join field” to “FIPS.”
- Set the “Target field” to “FIPS_COUNT.”
- Click “OK” to return to the Layer Properties window.

7. Setup your symbology.

- In the Layer Properties window, click the “Symbology” tab.
- From the top dropdown box, change the selection from “Single symbol” to “Graduated.”
- In the “Column” dropdown box, select the “HDI_HDI” column.
- You may modify the “Color ramp” if desired to change the coloring of your map.
- Set the mode to “Equal Interval.”
- Up the “Classes” to 88.
- Click the “Classify” button.
- Click the “Apply” button, then click “OK” to return to close the layer properties window and return to your map.

Your map is now complete. You can export your final product through the Project menu (Project > Import/Export > Export Map to Image).



Layers toolbar

Appendix C. HDI Data for Ohio Counties.

County	FIPS	AmerHDI	Health	Education	Income	Opioids	Benzos	Stimulants	Sedatives	MedAge
Adams	39001	3.61	3.81	4.00	3.01	95.9	38.3	7.3	4.9	42.1
Allen	39003	4.72	4.98	5.96	3.24	48.4	17.7	6.9	4.6	38.2
Ashland	39005	4.79	5.33	5.65	3.40	38.9	14.1	7.3	3.7	40.0
Ashtabula	39007	4.26	4.43	4.84	3.50	53.1	19.7	7.9	5.0	42.2
Athens	39009	3.40	4.54	7.64	-1.97	66.5	26.4	10.3	4.0	28.2
Auglaize	39011	5.27	5.48	5.56	4.77	52.3	23.4	8.6	5.1	41.2
Belmont	39013	4.45	4.81	5.31	3.24	57.5	21.5	5.0	6.2	44.1
Brown	39015	4.20	4.15	4.29	4.16	73.1	21.1	7.6	4.7	41.1
Butler	39017	5.32	4.95	6.37	4.65	62.6	32.4	13.7	6.4	36.5
Carroll	39019	4.51	5.12	4.68	3.75	42.4	18.6	6.1	3.6	44.7
Champaign	39021	4.83	4.75	5.39	4.35	66.2	21.3	9.4	4.3	41.6
Clark	39023	4.46	4.31	5.51	3.56	76.3	27.4	10.0	5.9	41.2
Clermont	39025	5.40	5.08	6.02	5.09	62.7	24.9	15.3	6.4	39.7
Clinton	39027	4.58	4.50	5.23	4.01	75.4	30.5	10.1	6.2	39.4
Columbiana	39029	4.38	4.85	4.93	3.37	59.9	30.1	9.0	6.0	43.4
Coshocton	39031	4.22	4.79	4.45	3.43	57.2	22.6	4.4	3.5	41.2
Crawford	39033	4.26	4.67	4.71	3.40	66	20.2	10.1	4.9	42.9
Cuyahoga	39035	5.51	4.95	6.99	4.59	40.7	14.9	8.6	4.1	40.4
Darke	39037	4.82	5.29	5.21	3.97	41.7	14.2	5.0	3.1	42.0
Defiance	39039	4.94	5.28	5.55	3.99	44.2	18.7	6.1	4.5	39.9
Delaware	39041	7.55	6.43	8.69	7.54	38.8	13.9	14.3	5.4	38.0
Erie	39043	4.96	4.98	5.98	3.92	63.9	23.3	9.8	7	44.5
Fairfield	39045	5.57	5.40	6.41	4.91	57.5	20.1	9.3	4.5	39.3
Fayette	39047	4.32	3.89	4.93	4.15	63.2	21.3	7.5	4.5	41.3
Franklin	39049	5.75	4.83	7.60	4.80	52.7	15.5	10.9	4.5	33.9
Fulton	39051	5.16	5.42	5.57	4.49	56.3	23.9	13.1	5.1	40.0
Gallia	39053	4.10	3.98	4.84	3.47	74.2	30	8.6	4.5	40.5
Geauga	39055	6.25	6.52	6.41	5.84	35.3	14.2	9.5	5	44.2
Greene	39057	6.19	5.66	8.22	4.71	43.6	17	6.6	3.8	38.0
Guernsey	39059	4.26	4.50	4.76	3.50	74.8	48.8	6.0	5.2	42.3
Hamilton	39061	5.52	4.68	7.21	4.67	49.1	20.7	13.1	5.5	37.0
Hancock	39063	5.59	5.61	6.67	4.49	38.1	17	6.7	5.0	38.9
Hardin	39065	3.98	4.54	5.01	2.40	55.6	22.2	6.6	3.9	35.8
Harrison	39067	4.16	4.31	4.14	4.01	69	22.9	6.5	6.1	46.2
Henry	39069	5.31	5.61	5.56	4.76	47.1	21.3	9.1	4.1	41.4
Highland	39071	4.12	4.22	4.78	3.38	72.3	25.1	7.5	4.9	40.2
Hocking	39073	4.45	4.46	5.38	3.51	88.2	30.2	9.2	6.1	42.7
Holmes	39075	3.32	5.57	1.11	3.27	18.6	12.5	3.0	2.5	30.6
Huron	39077	4.47	4.86	4.81	3.75	73.5	22.7	10.6	6.6	39.4
Jackson	39079	4.30	3.58	5.24	4.08	98.6	40.6	7.5	5.6	40.3
Jefferson	39081	4.33	4.08	5.50	3.42	79.2	35.2	6.4	7.0	44.5
Knox	39083	4.59	5.09	5.45	3.25	54.6	24	10.1	5.0	39.0
Lake	39085	5.85	5.53	6.65	5.37	50.5	18.9	9.2	5.7	43.3
Lawrence	39087	4.28	3.86	5.16	3.83	57.8	30.3	9.7	5.5	41.4
Licking	39089	5.29	5.03	6.33	4.50	53.8	16.9	10.0	4.0	39.8
Logan	39091	4.69	4.71	4.86	4.50	67.1	18.5	9.0	4.8	41.2
Lorain	39093	5.35	5.25	6.38	4.43	49.9	21.4	10.8	4.7	41.2
Lucas	39095	4.91	4.61	6.33	3.78	61.6	22	13.1	5.1	37.9

Madison	39097	5.06	4.83	5.70	4.64	76.6	25.2	9.9	5.2	40.2
Mahoning	39099	4.76	4.68	6.26	3.33	64.7	29.9	10.2	5.6	43.4
Marion	39101	4.47	4.62	5.06	3.73	77.9	26.5	10.3	3.8	40.5
Medina	39103	6.11	5.94	6.88	5.51	42.6	17.6	10.4	5.0	41.8
Meigs	39105	4.10	4.13	4.71	3.46	64.4	23.8	7.6	3.6	42.8
Mercer	39107	5.15	5.55	5.27	4.63	36.0	19.3	4.8	3.8	40.0
Miami	39109	5.34	5.35	6.06	4.60	54.4	25.5	9.4	4.7	41.4
Monroe	39111	4.02	4.85	4.66	2.55	43.8	19.3	4.0	4.6	46.3
Montgomery	39113	5.13	4.55	6.87	3.98	63.5	28.6	8.4	5.7	39.4
Morgan	39115	4.00	4.86	4.00	3.15	62.1	26.8	5.9	3.1	43.8
Morrow	39117	4.77	5.10	4.97	4.25	58.1	16.3	7.5	3.2	41.5
Muskingum	39119	4.48	4.60	5.22	3.61	77.6	47.9	8.4	5.8	40.2
Noble	39121	3.84	6.27	4.68	0.56	39.6	31.5	3.7	3.7	47.9
Ottawa	39123	5.32	5.56	5.86	4.53	59.8	26.2	9.2	6.2	47.8
Paulding	39125	4.79	5.15	5.11	4.10	48.1	18.5	5.0	4.4	41.3
Perry	39127	4.19	4.43	4.52	3.62	91.9	41.8	8.0	5.3	39.8
Pickaway	39129	4.85	4.79	5.33	4.41	77.2	22.5	8.8	4.7	39.3
Pike	39131	3.96	3.65	4.24	4.01	89.1	35.8	6.5	5.9	40.8
Portage	39133	5.03	5.37	6.42	3.30	51.8	17.6	9.0	5.5	37.7
Preble	39135	4.75	4.75	5.35	4.16	61.4	25.6	7.7	4.9	42.2
Putnam	39137	5.58	5.85	6.10	4.77	35.8	15.0	4.9	4.2	39.4
Richland	39139	4.53	4.92	5.36	3.31	50.0	15.4	7.2	5.3	41.2
Ross	39141	4.63	4.11	5.39	4.40	86.9	44.3	9.0	6.1	40.4
Sandusky	39143	4.94	5.03	5.42	4.37	46.8	17.5	6.8	4.1	41.5
Scioto	39145	4.21	3.65	5.24	3.73	87.4	37.1	6.9	6.1	39.7
Seneca	39147	4.72	5.06	5.53	3.58	54.4	22.6	7.6	5.7	39.4
Shelby	39149	5.17	5.30	5.41	4.80	43.6	22.9	5.5	3.2	39.5
Stark	39151	5.15	5.22	6.29	3.94	59.3	33.7	11.7	6.7	41.7
Summit	39153	5.56	5.01	6.99	4.68	54.1	18.9	9.0	5.0	40.8
Trumbull	39155	4.58	4.74	5.19	3.8	78.3	27.0	8.1	5.4	43.8
Tuscarawas	39157	4.72	5.36	5.01	3.79	57.7	29.4	7.0	6.1	40.9
Union	39159	5.95	5.45	6.58	5.82	49.6	15.3	11.4	4.2	38.2
Van Wert	39161	5.10	5.34	5.59	4.36	40.9	15.9	5.3	3.3	41.4
Vinton	39163	3.81	3.86	4.01	3.57	89.9	30.3	6.1	3.9	41.0
Warren	39165	6.60	5.67	7.51	6.61	45.7	22.0	11.8	5.8	39.1
Washington	39167	4.62	4.85	5.27	3.76	70.7	37.4	9.9	7.0	43.6
Wayne	39169	4.83	5.35	5.27	3.86	47.8	20	9.4	5.1	38.8
Williams	39171	4.85	5.38	5.30	3.86	38.1	15.0	6.7	3.4	41.6
Wood	39173	5.45	5.55	7.23	3.56	44.3	18.7	11.5	4.9	34.7
Wyandot	39175	5.11	5.28	5.34	4.71	44.5	20.1	8.3	3.8	41.7