Displacement Risk Index
Puget Sound Region
2021

Methodology

Contents

Indicators 3
Indicator 01 - People of color 3
Indicator 02 – Linguistic Isolation 5
Indicator 03 – Educational attainment 7
Indicator 04 – Housing Tenancy 9
Indicator 05 – Cost-burdened households (cost-burdened and severely cost-burdened households) 11
Indicator 06 – Household income 15
Indicator 07 – Proximity to job center 18
Indicator 08 – Proximity to transit 20
Indicator 09 – Proximity to current or future link light rail & streetcar 21
Indicator 10 – Proximity to core business 22
Indicator 11 – Proximity to civic infrastructure 25
Indicator 12 – Proximity to high-income neighborhood 27
Indicator 13 – Development capacity 29
Indicator 14 – Median rent 30
Indicator 15 – Voter turnout 35
Calculation: 35
Data: 36
Displacement risk index analysis 39
Classification 39
Merging 40
Estimation 41
Assignment to final categories using breakpoints 41
Appendix 42

Indicators

Indicator 01 - People of color

From ACS table B03002, we can estimate the percentage of population that is a race other than non-Hispanic White (per_minority) by tract. The table has estimates and margin of errors for the following indicators:

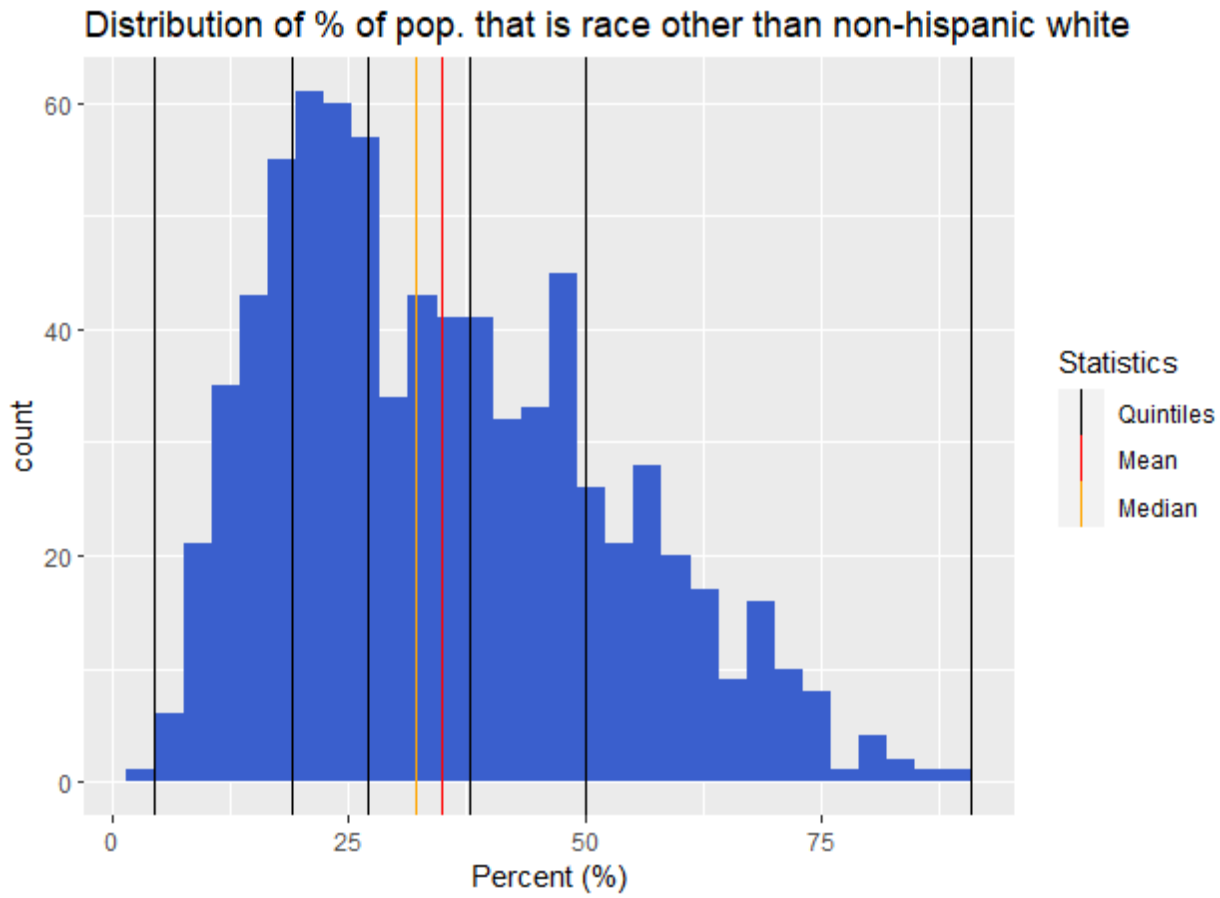
- Total number of people by tract (pop)
- Total number of Hispanic White people by tract (hw)
- Total number of non-Hispanic White people by tact (nhw)
- Total number of Hispanic people by tract (h)
- Total number of non-Hispanic people by tract (nh)

With these values, the percentage of people that is a race other than non-Hispanic White (per_minority) by tract is estimated as:

$$per_minority = \frac{h + nh - nhw}{pop} * 100\%$$

Summary - Indicator 01		
Description		Percent of population that is a race other than non-Hispanic White by tract
Source		American Community Survey/Tidycensus
Table		B03002
Year		2015-2019
Quintiles	0%	4%
	20%	19%
	40%	27%
	60%	38%
	80%	5%
	100%	91%
Classification	0	>20%
	1	20 - 30%
	2	30 - 40%
	3	40 - 50%
	4	>50%

.


Distribution of % of pop. that is race other than non-hispanic white
count
60
40
20
0
0
25
50
75
Percent (%)
Statistics
Quintiles
Mean
Median

Indicator 02 – Linguistic Isolation

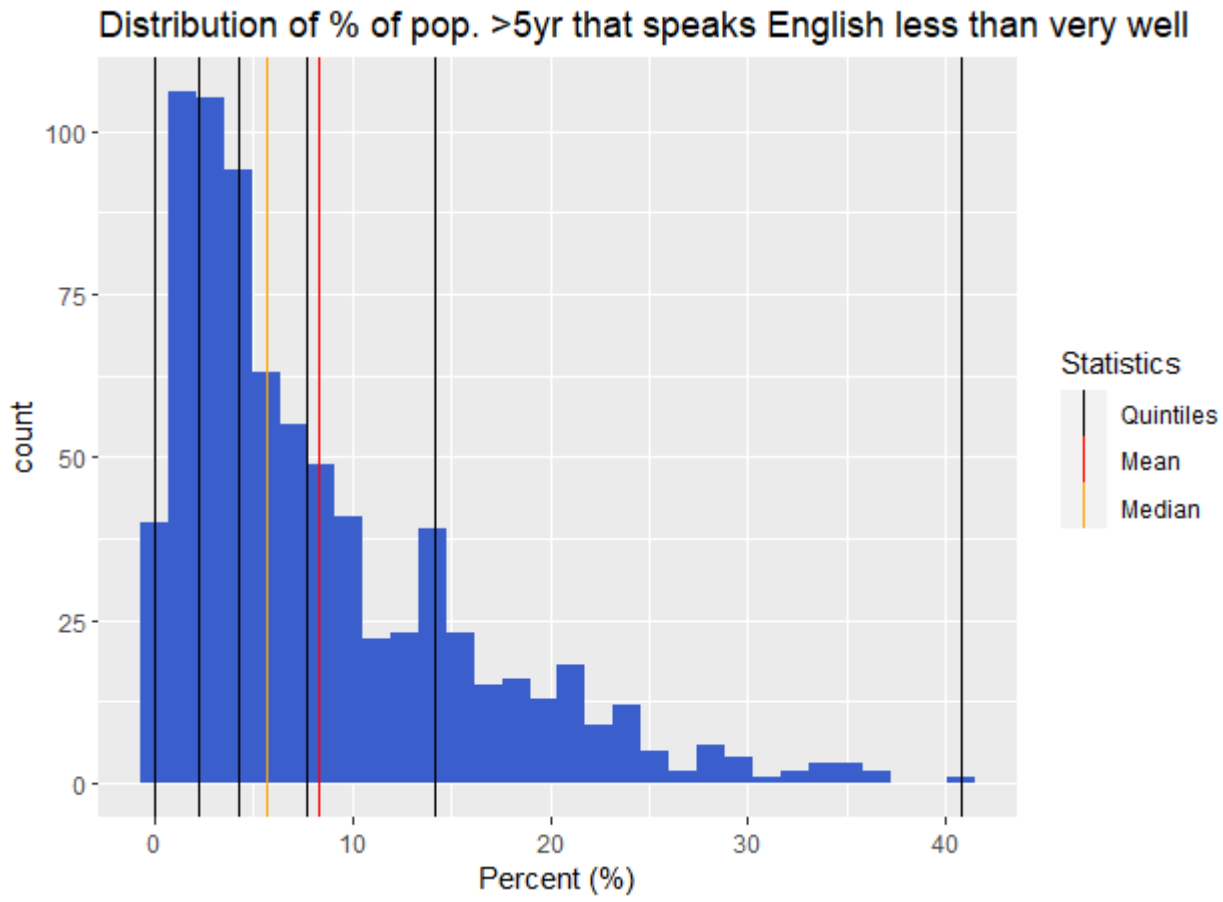
From ACS table C16001, we can estimate the percent of population 5+ that speak English less than very well by tract (per_noeng). The table has estimates and margin of errors for the following indicators:

- Total number of people >= 5 years old by tract (pop5)
- People that speak Spanish and English less than very well (spn)
- People that speak French, Haitian or Cajun, and English less than very well (frn)
- People that speak German or other West Germanic Language, and English less than very well (ger)
- People that speak Russian, Polish or other Slavic language, and English less than very well (rus)
- People that speak other Indo-European languages, and English less than very well (eur)
- People that speak Korean and English less than very well (kor)
- People that speak Mandarin or Cantonese, and English less than very well (chn)
- People that speak Vietnamese and English less than very well (vnm)
- People that speak Tagalog and English less than very well (tag)
- People that speak Other Asian and Pacific Island languages, and English less than very well (asn)
- People that speak Arabic and English less than very well (arb)
- People that speak other and unspecified languages, and English less than very well (oth)

With these values, the population 5+ that speak English less than very well by tract (per_noeng) is simply estimated as the number of people that speak other languages than English, and English less than very well:

$$per_noeng = \frac{spn + frn + ger + rus + eur + kor + chn + vnm + tag + asn + arb + oth}{pop5} * 100\%$$

Summary – Indicator 02		
Description		Percent of population 5+ that speak English less than very well by tract
Source		American Community Survey/Tidycensus
Table		C16001
Year		2015-2019
Quintiles	0%	0%
	20%	2%
	40%	4%
	60%	8%
	80%	14%
	100%	41%
Classification	0	<4%
	1	4 – 8%
	2	8 – 12%
	3	12 – 16%
	4	>16%



.

Indicator 03 – Educational attainment

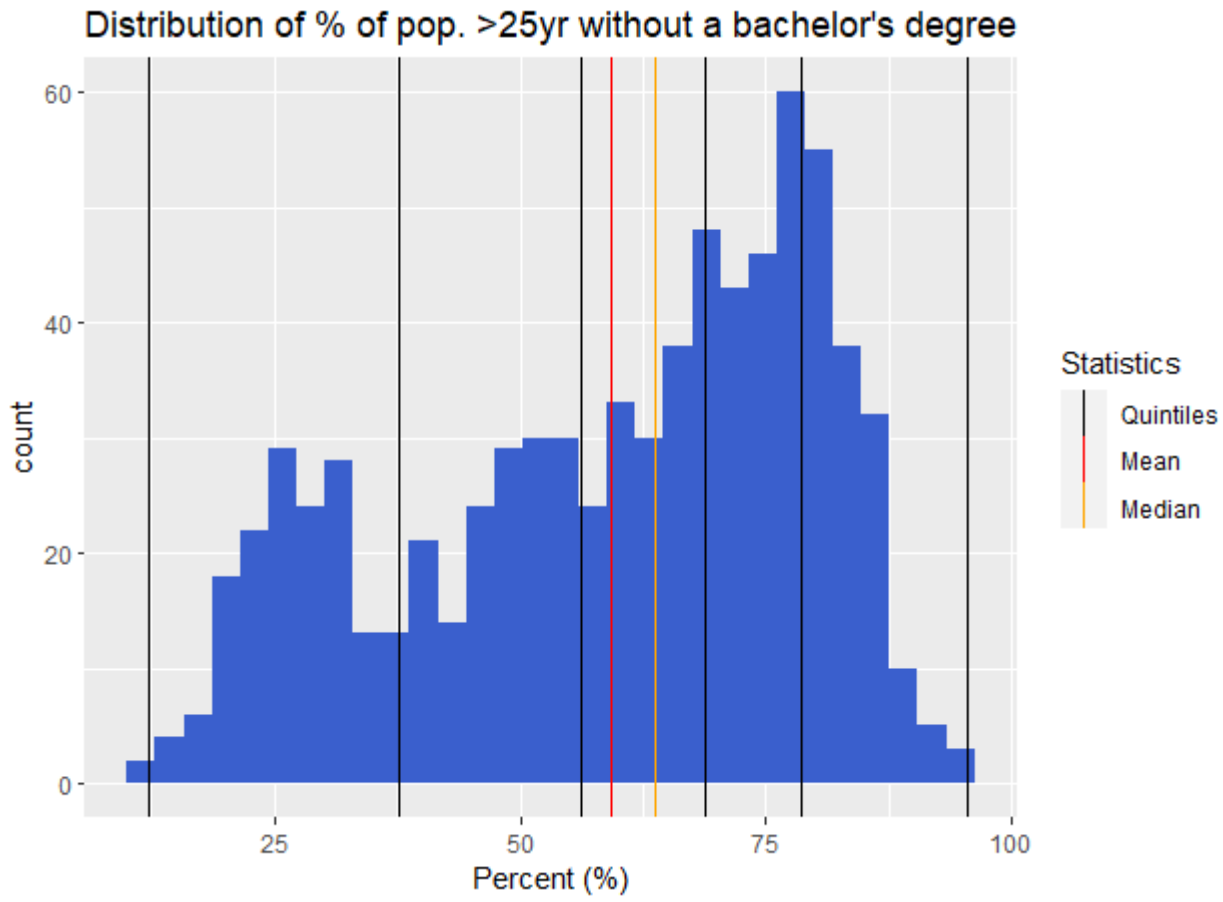
From ACS table B15003, we can estimate the percent of population 25+ who lack a bachelor's degree by tract (per_nobac). The table has estimates and margin of errors for the following indicators:

- Total number of people by tract (pop)
- People 25+ that hold a bachelor's degree (bac)
- People 25+ that hold a master's degree (mas)
- People 25+ that hold a Professional school degree (pro)
- People 25+ that hold a Doctorate degree (phd)

With these values, the percent of population 25+ who lack a bachelor's degree by tract (per_nobac) is estimated as the difference between the population and the population that hold a bachelor's degree or higher:

$$per_nobac = \frac{pop - bac - mas - pro - phd}{pop} * 100\%$$

Summary – Indicator 03		
Description		Percent of population 25+ who lack a bachelor's degree
Source		American Community Survey/Tidycensus
Table		B15003
Year		2015-2019
Quintiles	0%	12%
	20%	38%
	40%	56%
	60%	69%
	80%	79%
	100%	95%
Classification	0	<15%
	1	35 - 50%
	2	50 - 65%
	3	65 - 80%
	4	>80%


Distribution of % of pop. >25yr without a bachelor's degree
count
60
40
20
0
25
50
75
100
Percent (%)
Statistics
Quintiles
Mean
Median

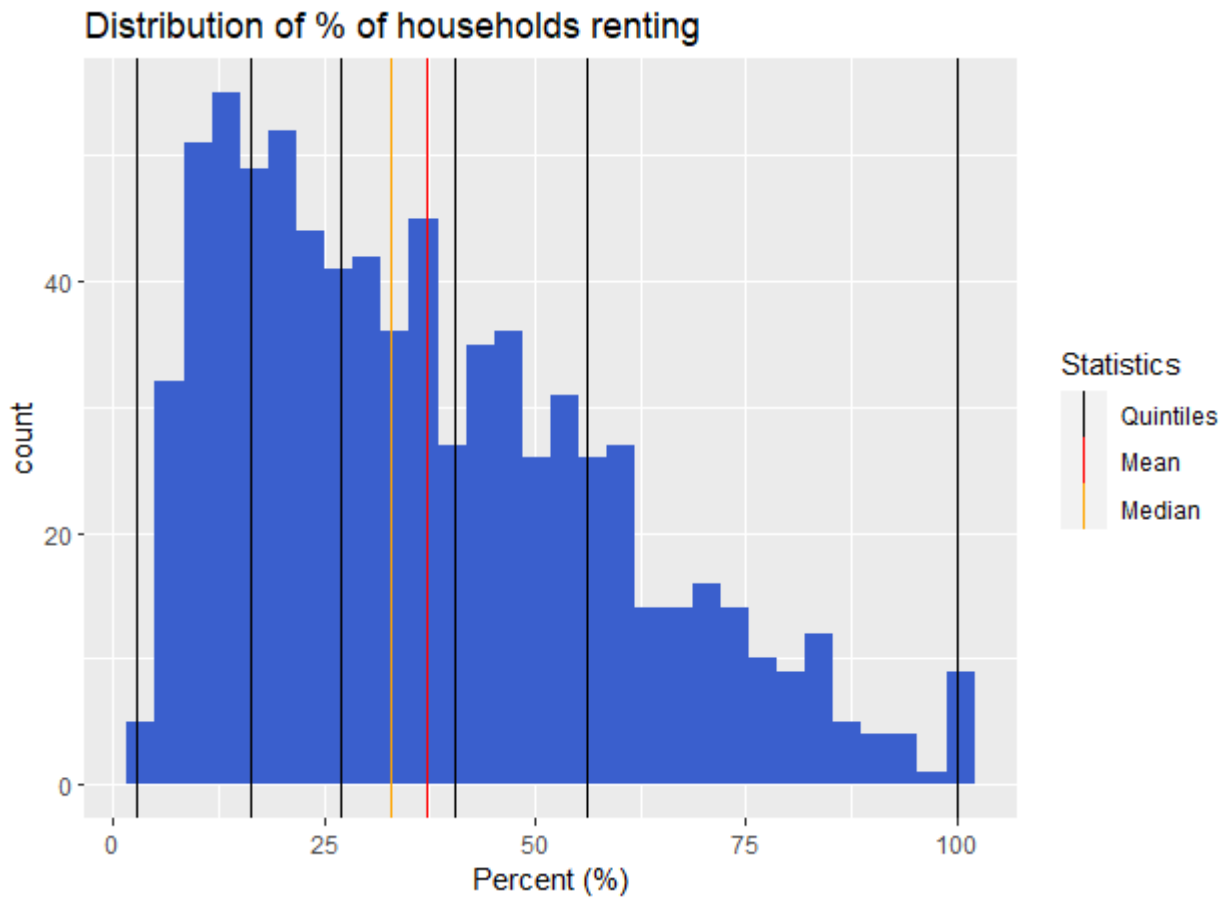
Indicator 04 – Housing Tenancy

To estimate the percent of households that are renters by tract (per_rent), the calculation is straightforward since the ACS table B25003 already contains the information needed:

- Total number of households by tract (hh)
- Total number of households that are renters by tract (rent)

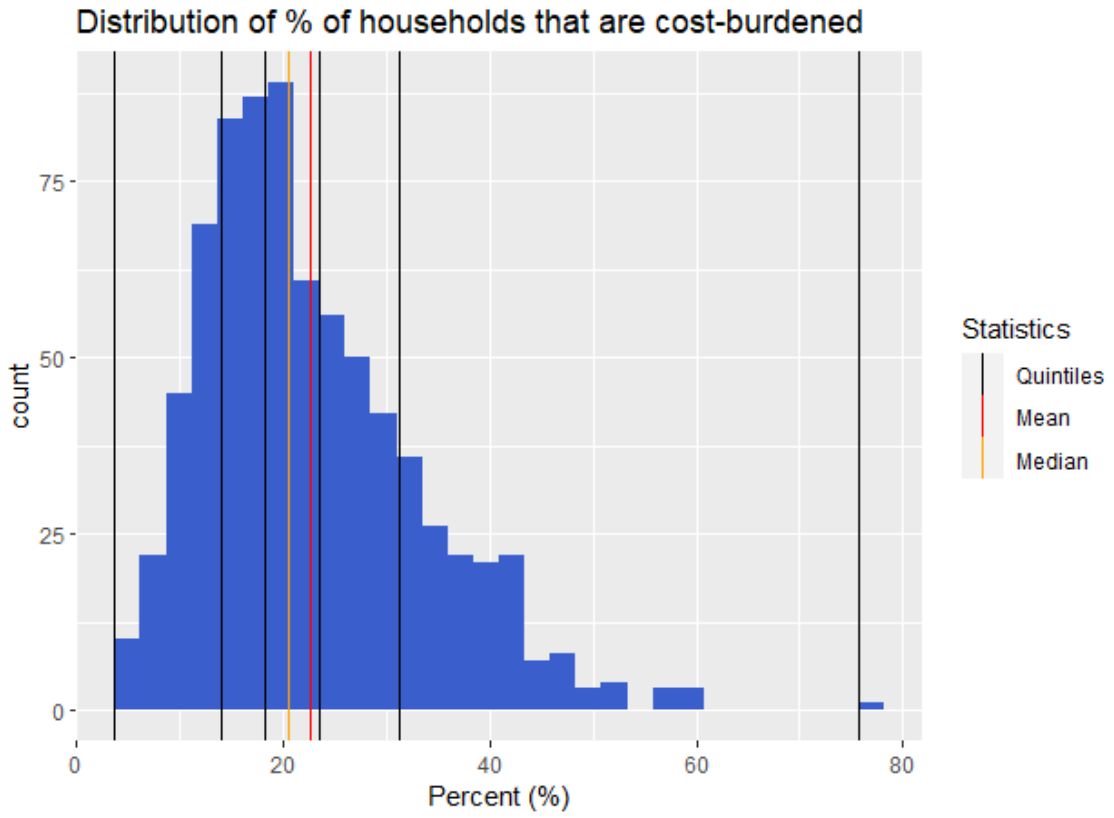
The percent of households that are renters by tract (per_rent) is estimated as: $per_rent = \frac{rent}{hh} * 100\%$

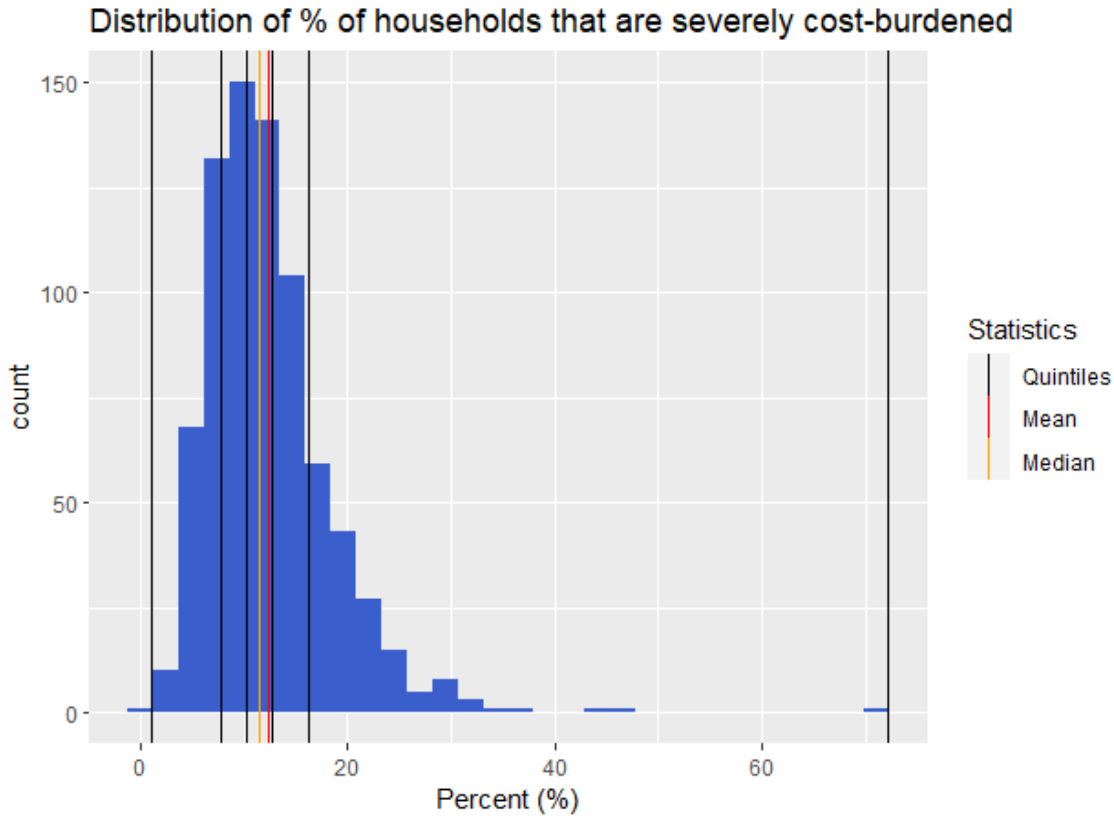
Summary – Indicator 04		
Description		Percent of households that are renters
Source		American Community Survey/Tidycensus
Table		B25003
Year		2015-2019
Quintiles	0%	3%
	20%	16%
	40%	27%
	60%	41%
	80%	56%
	100%	100%
Classification	0	<15%
	1	15 - 30%
	2	30 - 45%
	3	45 - 60%
	4	>60%


Distribution of % of households renting
count
40
20
0
0
25
50
75
100
Percent (%)
Statistics
Quintiles
Mean
Median

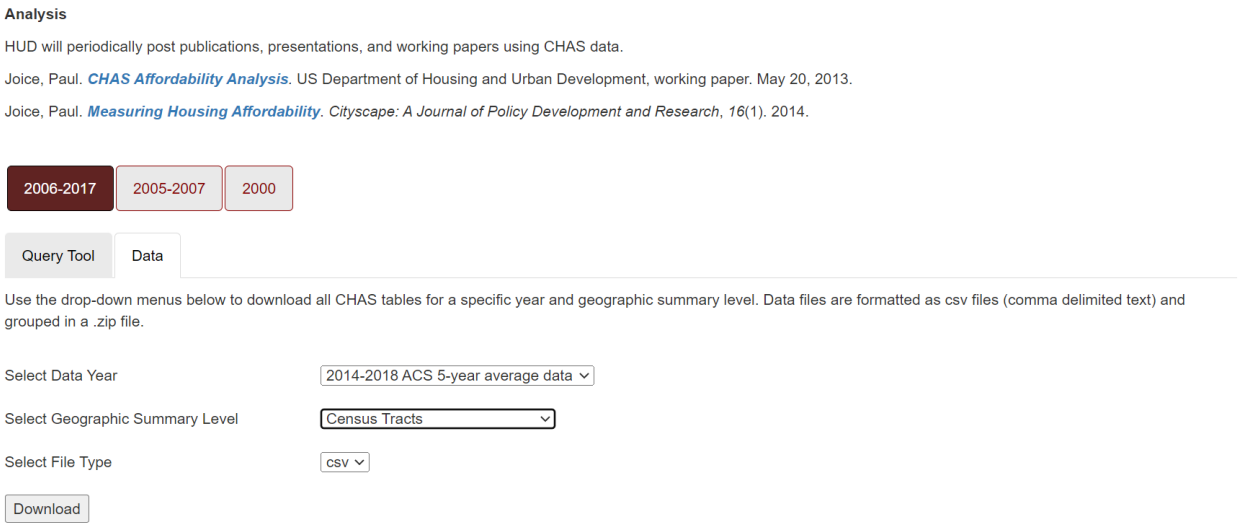
Indicator 05 – Cost-burdened households (cost-burdened and severely cost-burdened households)

Summary – Indicator 05		
Description		Cost-burdened households: Percent of households with income <80% of area median income (AMI) paying >30% of income on housing. Severely Cost-burdened households: Percent of households with income <80% of AMI paying >50% of income on housing.
Source		Comprehensive Household Affordability Strategy data (CHAS)
Link to download		https://www.huduser.gov/portal/datasets/cp/2014thru2018-140-csv.zip
Year		2014-2018
Cost-burdened households		
Quintiles	0%	4%
	20%	14%
	40%	18%
	60%	23%
	80%	31%
	100%	76%
Classification	0	<10%
	1	10 – 15%
	2	15 – 20%
	3	20 – 25%
	4	>25%
Severely cost-burdened households		
Quintiles	0%	1%
	20%	8%
	40%	10%
	60%	13%
	80%	16%
	100%	72%
Classification	0	<10%
	1	10 – 15%
	2	15 – 20%
	3	20 – 25%
	4	>25%


Distribution of % of households that are cost-burdened
count
75
50
25
0
0
20
40
60
80
Percent (%)
Statistics
Quintiles
Mean
Median

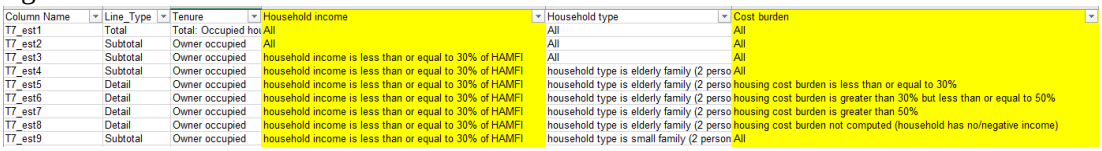

Distribution of % of households that are severely cost-burdened
count
150
100
50
0
0
20
40
60
Percent (%)
Statistics
Quintiles
Mean
Median

Data on cost-burdened household can be downloaded from the CHAS database. This database can be downloaded from the U.S. Department of Housing and Urban Development website. The data can be downloaded by using the R script (DataGen_05_CostBurden.R) or it can be done manually as followed[1]:



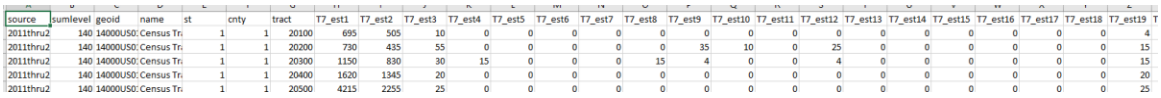
The CHAS database contains several files, but we only need two:

- **CHAS data dictionary 14-18.xlsx**
  This file contains the data dictionary. This database is useful to read the data and choose the right variables/column names.



Column Name	Line_Type	Tenure	Household income	Household type	Cost burden
T7_est1	Total	Total: Occupied hou	All	All	All
T7_est2	Subtotal	Owner occupied	All	All	All
T7_est3	Subtotal	Owner occupied	household income is less than or equal to 30% of HAMFI	All	All
T7_est4	Subtotal	Owner occupied	household income is less than or equal to 30% of HAMFI	household type is elderly family (2 perso	All
T7_est5	Detail	Owner occupied	household income is less than or equal to 30% of HAMFI	household type is elderly family (2 perso	housing cost burden is less than or equal to 30%
T7_est6	Detail	Owner occupied	household income is less than or equal to 30% of HAMFI	household type is elderly family (2 perso	housing cost burden is greater than 30% but less than or equal to 50%
T7_est7	Detail	Owner occupied	household income is less than or equal to 30% of HAMFI	household type is elderly family (2 perso	housing cost burden is greater than 50%
T7_est8	Detail	Owner occupied	household income is less than or equal to 30% of HAMFI	household type is elderly family (2 perso	housing cost burden not computed (household has no/negative income)
T7_est9	Subtotal	Owner occupied	household income is less than or equal to 30% of HAMFI	household type is small family (2 person	All

- **Table7.csv**
  We are only interested in Table 7, since it contains the information related to Cost Burden and Household income.



source	sumlevel	geoid	name	st	cnty	tract	T7_est1	T7_est2	T7_est3	T7_est4	T7_est5	T7_est6	T7_est7	T7_est8	T7_est9	T7_est10	T7_est11	T7_est12	T7_est13	T7_est14	T7_est15	T7_est16	T7_est17	T7_est18	T7_est19
2011thru2	140	14000US0	Census Tr	1	1	20100	695	505	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
2011thru2	140	14000US0	Census Tr	1	1	20200	730	435	55	0	0	0	0	0	35	10	0	25	0	0	0	0	0	0	15
2011thru2	140	14000US0	Census Tr	1	1	20300	1150	830	30	15	0	0	0	15	4	0	0	4	0	0	0	0	0	0	15
2011thru2	140	14000US0	Census Tr	1	1	20400	1620	1345	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
2011thru2	140	14000US0	Census Tr	1	1	20500	4215	2255	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25

The columns in Table 7 are named with codes that include a T7_est(#) label. In order to choose the right columns, we identified the labels from the CHAS data dictionary as followed.

[1] One problem with the CHAS database is its size (it contains all U.S. counties). The R script contains functions to subset the data by King, Kitsap, Pierce and Snohomish counties.

- **Cost-burdened households:**
  Such households have a housing cost burden that is greater than 30% and a household income that is less than or equal to 80% of Housing Urban Development Area Median Family Income (HAMFI). The Table 7 column labels for these households are:
  - T7_est6, T7_est7, T7_est11, T7_est12, T7_est16, T7_est17, T7_est21, T7_est22, T7_est26, T7_est27, T7_est32, T7_est33, T7_est37, T7_est38, T7_est42, T7_est43, T7_est47, T7_est48, T7_est52, T7_est53, T7_est58, T7_est59, T7_est63, T7_est64, T7_est68, T7_est69, T7_est73, T7_est74, T7_est78, T7_est79, T7_est137, T7_est138, T7_est142, T7_est143, T7_est147, T7_est148, T7_est152, T7_est153, T7_est157, T7_est158, T7_est163, T7_est164, T7_est168, T7_est169, T7_est173, T7_est174, T7_est178, T7_est179, T7_est183, T7_est184, T7_est189, T7_est190, T7_est194, T7_est195, T7_est199, T7_est200, T7_est204, T7_est205, T7_est209, T7_est210

  Summing these columns will result in the number of cost-burdened households by tract (cb).

- **Severely Cost-burdened households:**
  Such households have a housing cost burden that is greater than 50% and a household income that is less than or equal to 80% of HAMFI. The Table 7 column labels for this households are:

  - T7_est7, T7_est12, T7_est17, T7_est22, T7_est27, T7_est33, T7_est38, T7_est43, T7_est48, T7_est53, T7_est59, T7_est64, T7_est69, T7_est74, T7_est79, T7_est138, T7_est143, T7_est148, T7_est153, T7_est158, T7_est164, T7_est169, T7_est174, T7_est179, T7_est184, T7_est190, T7_est195, T7_est200, T7_est205, T7_est210.

  Summing these columns will result in the number of severely cost-burdened households by tract (scb).

- **Other labels:**
  The last value that we used for this analysis contains the number of households by tract (hh). The column label for this value is T7-est1.

With these values, the percent of percent of cost-burdened households and severely cost-burdened households is:

Percent of Cost-burdened households by tract:

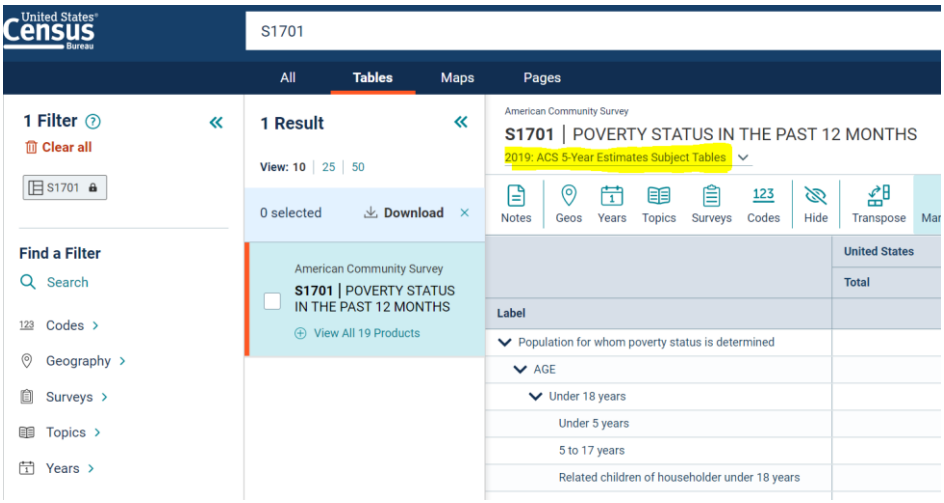
$$per_cb = \frac{cb}{hh} * 100\%$$

Percent of Severely Cost-burdened households by tract:

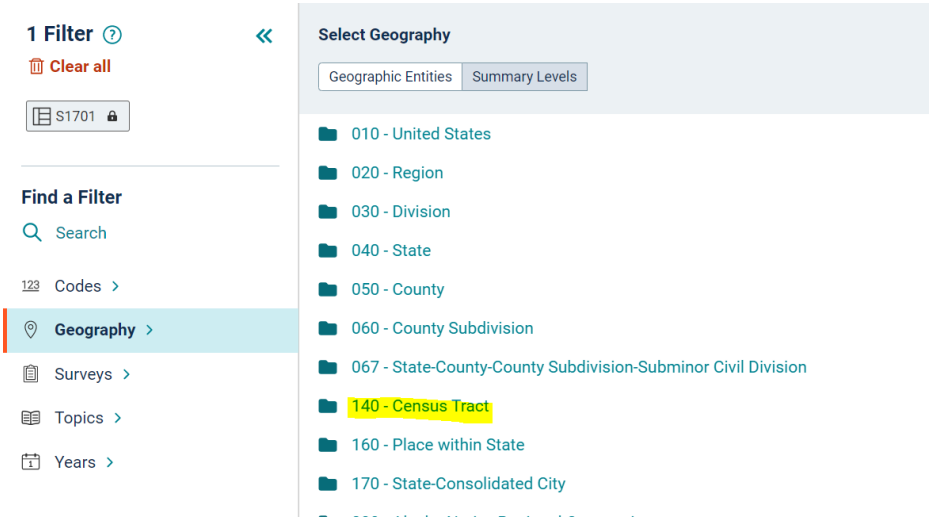
$$per_scb = \frac{scb}{hh} * 100\%$$

Indicator 06 – Household income

Table S1701 is not available in the tidycensus R library, for this reason it was directly downloaded from the ACS website. We entered the table id into the search field, then specified the year as "2019: ACS 5-Year Estimates Subject Tables" (see image below)



and geography as Geography > Summary Levels > 140 Census Tract (see image below) > Washington > All Census Tracts within Washington.



After applying these filters and downloading the data, the ACS website provides a folder with several files; however, we only need the one named ACSST5Y2019.S1701_data_with_overlays_2022-05-03T014840.csv (renamed to ACS_19_5YR_S1701.csv in the 06-HouseholdIncome data folder).

From this .csv file we need the values labeled as:

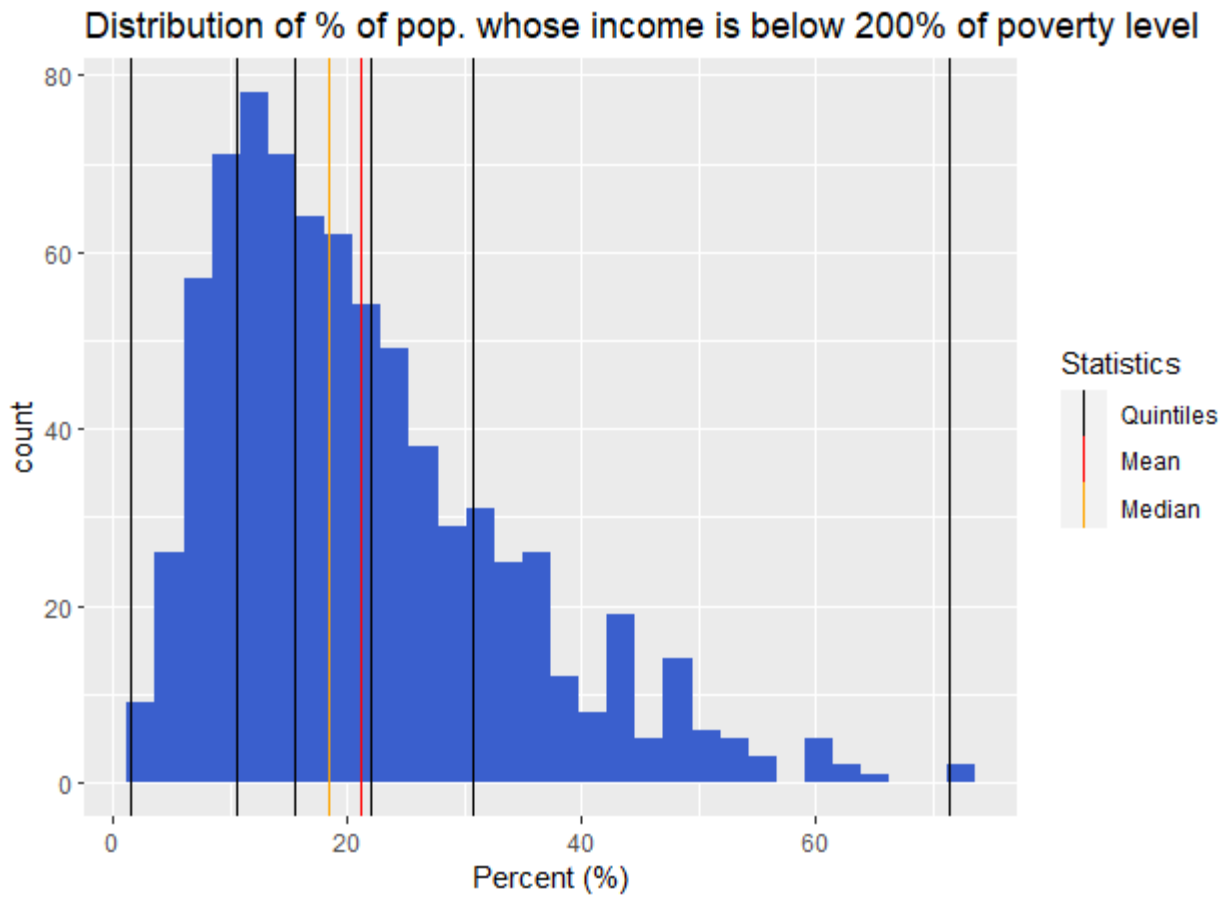
- **S1701_C01_042E**
  This value contains the population for whom poverty status is determined by tract (pop_pov)
- **S1701_C01_001E**

This value contains the number of individuals with income below the 200 percent of poverty level (pov200)

With these values, the percent of population whose income is below 200% (per_pov200) of poverty level) is:

$$per_pov200 = \frac{pov200}{pop_pov} * 100\%$$

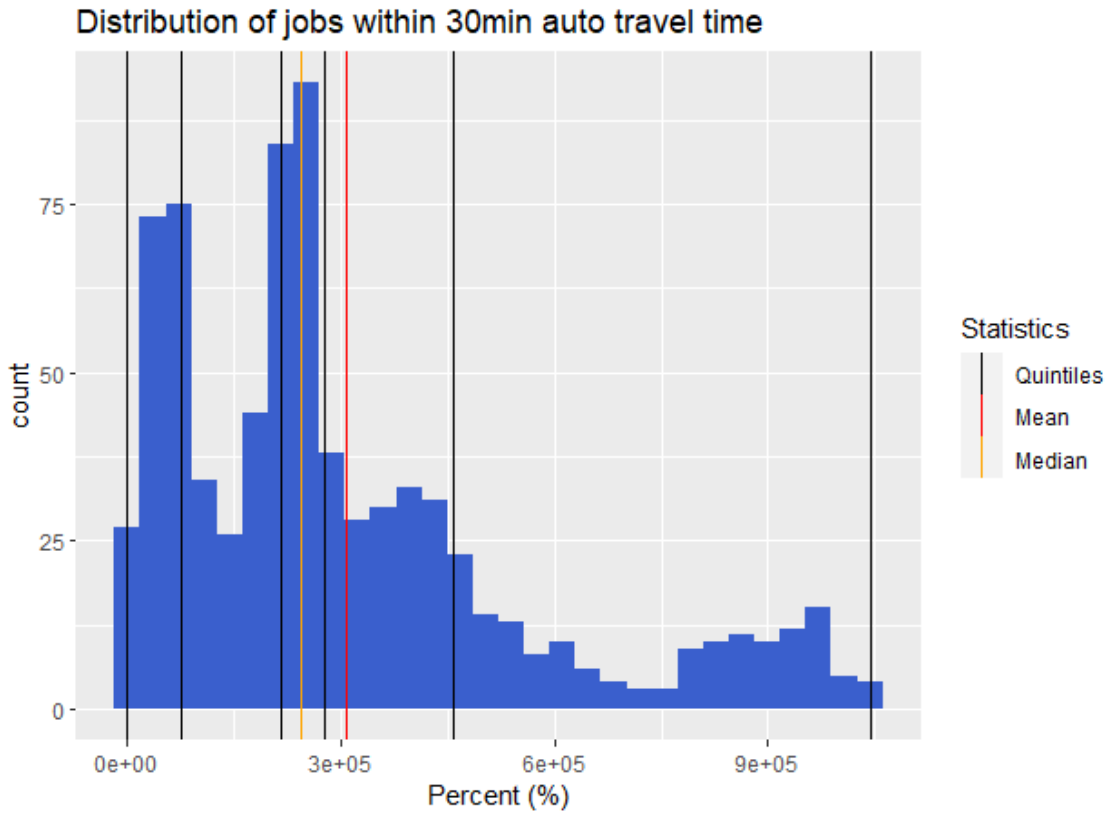
Summary – Indicator 06		
Description		Percent of population whose income is below 200% of poverty level
Source		American Community Survey
Table		S1701
Year		2015-2019
Quintiles	0%	1%
	20%	11%
	40%	16%
	60%	22%
	80%	31%
	100%	71%
Classification	0	<8%
	1	8 – 16%
	2	16 – 24%
	3	24 – 32%
	4	>32%

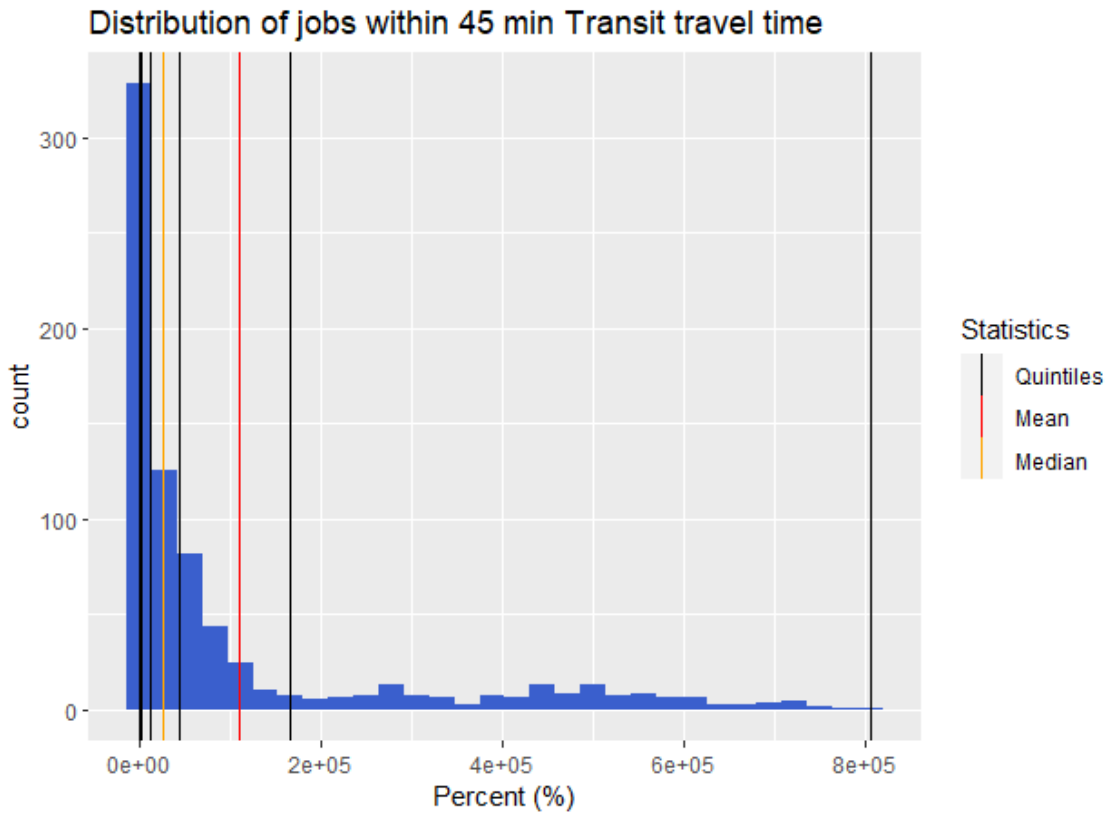

Distribution of % of pop. whose income is below 200% of poverty level
count
80
60
40
20
0
0
20
40
60
Percent (%)
Statistics
Quintiles
Mean
Median

Indicator 07 – Proximity to job center

This indicator was created internally by PSRC using SoundCast modeling. Contact SoundCast developers to generate this dataset for the most recent base year.

Summary – Indicator 07		
Description		Proximity to jobs by auto: Number of jobs within 30 min travel time by auto Proximity to jobs by transit: Number of jobs within 45 min travel time by transit (includes walking and waiting time)
Source		PSRC
Year		2018 base year
Jobs by Auto		
Quintiles	0%	0
	20%	75,642
	40%	215,139
	60%	276,182
	80%	458,013
	100%	1,043,309
Classification	0	<75K
	1	75 – 200K
	2	200 – 325K
	3	325 – 450K
	4	>450K
Jobs by Transit		
Quintiles	0%	0
	20%	1,119
	40%	12,030
	60%	43,562
	80%	167,010
	100%	806,537
Classification	0	<1K
	1	1 – 13K
	2	13 – 43K
	3	43 – 200K
	4	>200K

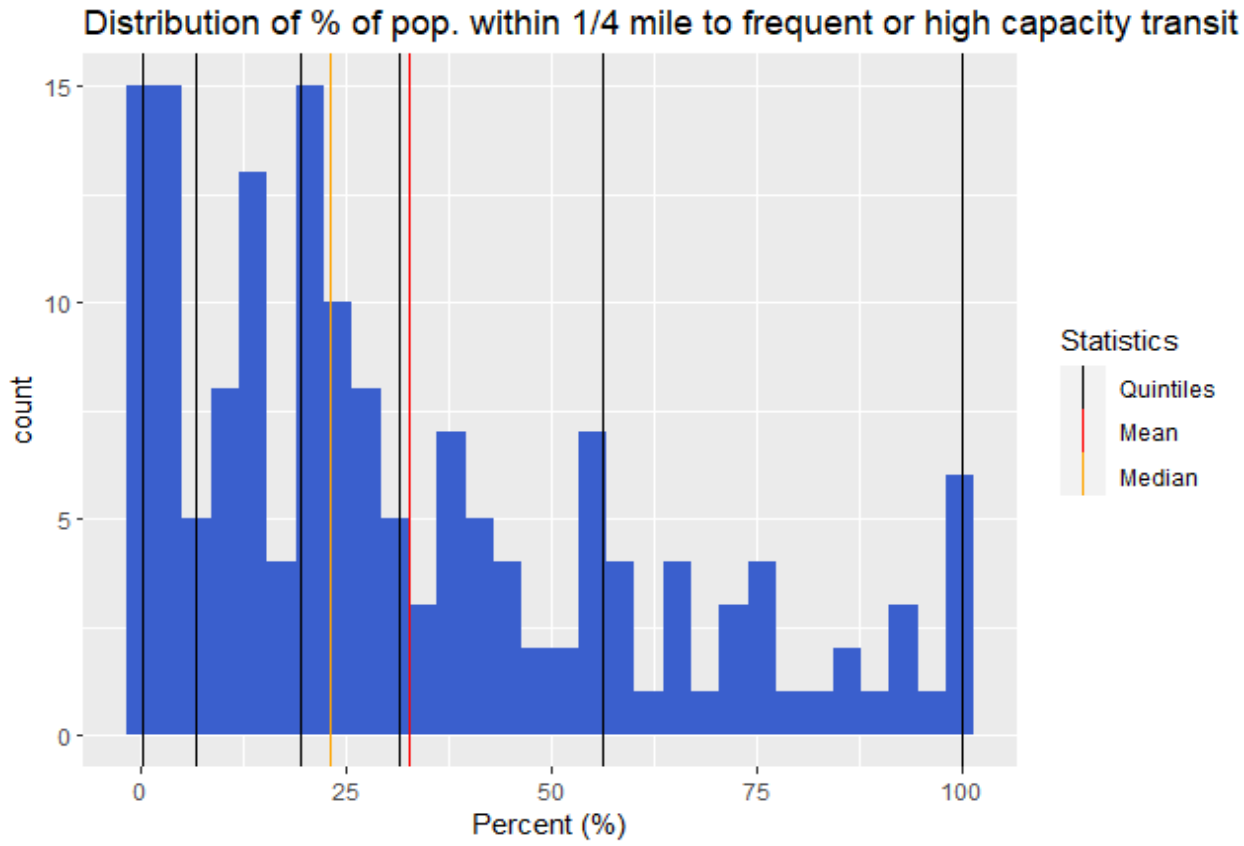

Distribution of jobs within 30min auto travel time
count
75
50
25
0
0e+00
3e+05
6e+05
9e+05
Percent (%)
Statistics
Quintiles
Mean
Median


Distribution of jobs within 45 min Transit travel time
count
300
200
100
0
0e+00
2e+05
4e+05
6e+05
8e+05
Percent (%)
Statistics
Quintiles
Mean
Median

Indicator 08 – Proximity to transit

This indicator was created internally by PSRC using SoundCast modeling. Contact SoundCast developers to generate this dataset for the most recent base year.

Summary – Indicator 08		
Description		Percent of population within ¼ mile to frequent or high-capacity transit
Source		PSRC
Year		2018 base year
Quintiles	0%	0%
	20%	7%
	40%	20%
	60%	32%
	80%	56%
	100%	100%
Classification	0	<6%
	1	6%-24%
	2	24%-42%
	3	42%-60%
	4	>60%

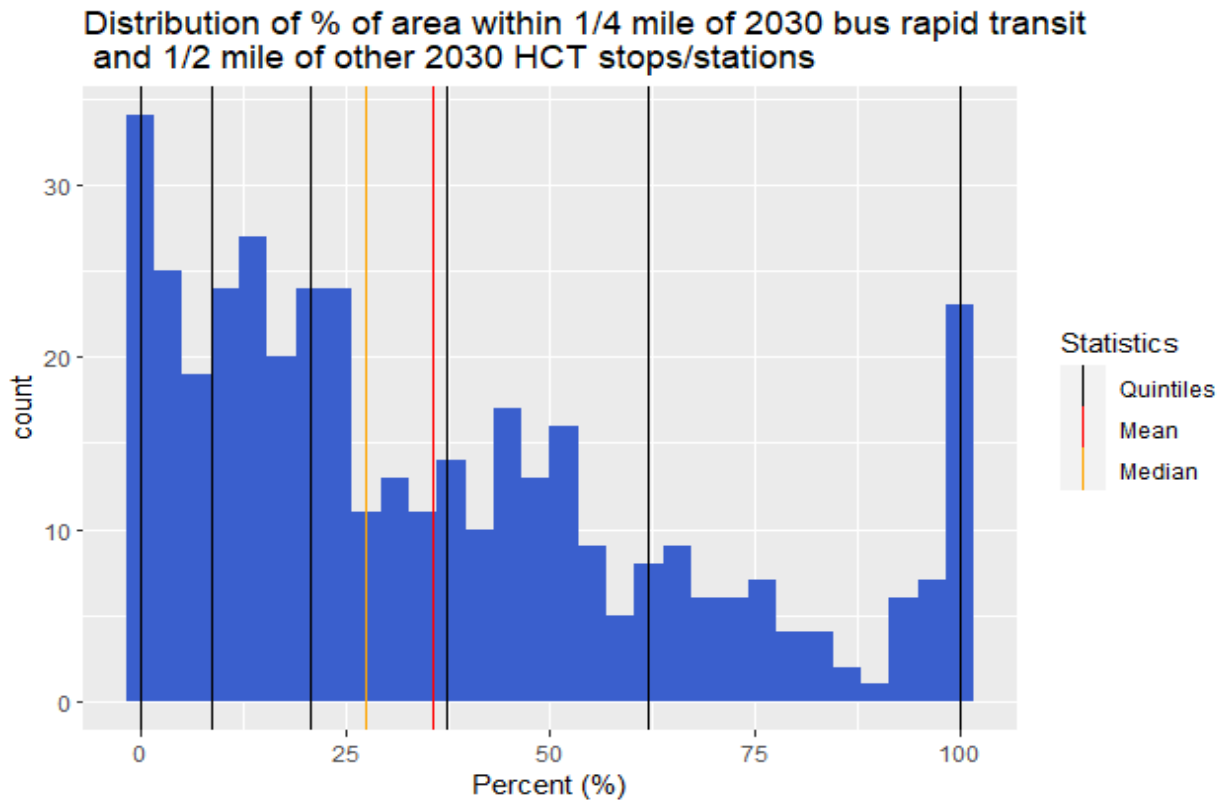


Note: Tracts with 0% of the population within ¼ mi. to frequent or high-capacity transit have been excluded in the figure above.

Indicator 09 – Proximity to current or future link light rail & streetcar

This indicator was created internally by PSRC using SoundCast modeling. Contact SoundCast developers to generate this dataset for the most recent base year.

Summary – Indicator 09		
Description		Percent of area within ¼ mile of 2030 bus rapid transit (BRT) and ½ mile of other 2030 high-capacity transit (HCT) stops/stations
Source		PSRC
Year		2030
Quintiles	0%	1%
	20%	9%
	40%	21%
	60%	37%
	80%	56%
	100%	100%
Classification	0	<6%
	1	6%-24%
	2	24%-42%
	3	42%-60%
	4	>60%

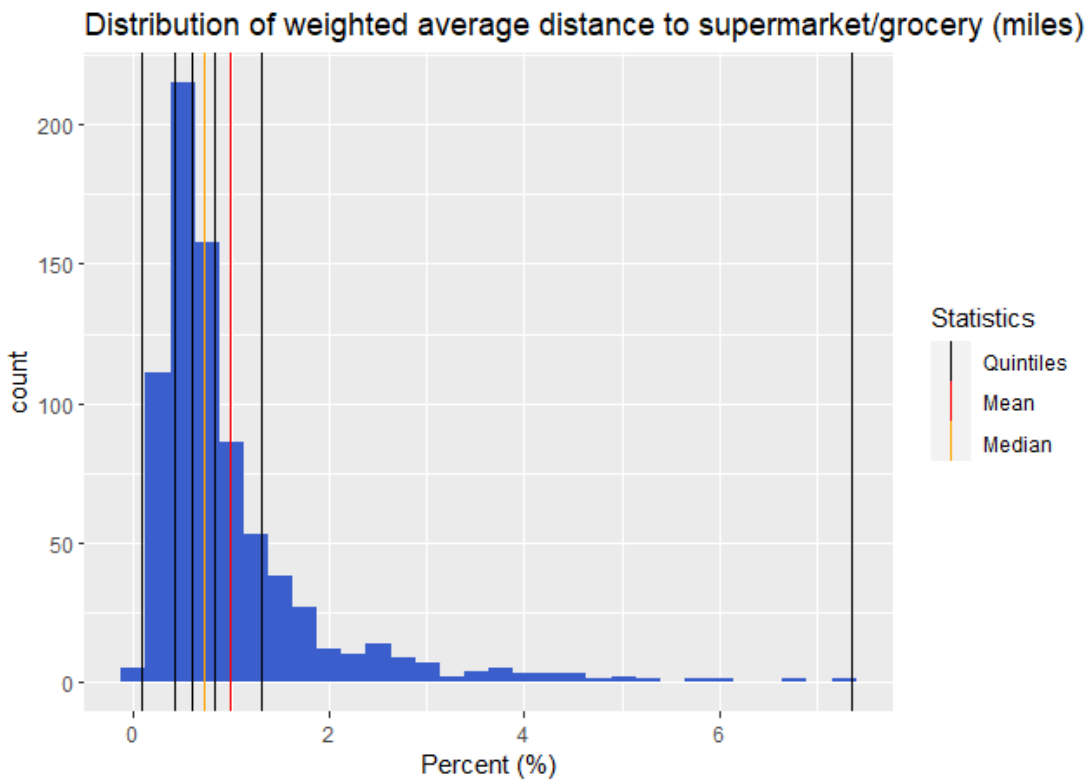


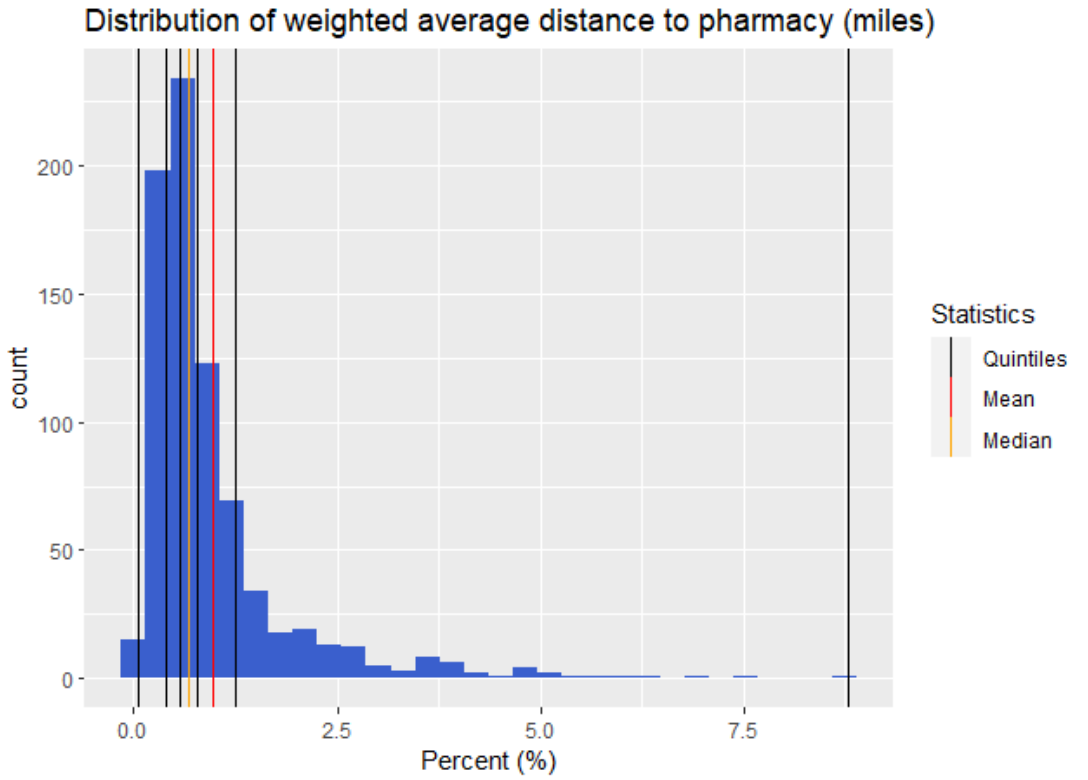
Note: Tracts with 0% of area within ¼ mi. to 2030 BRT and ½ mi. to 2030 HCT have been excluded in the figure above.

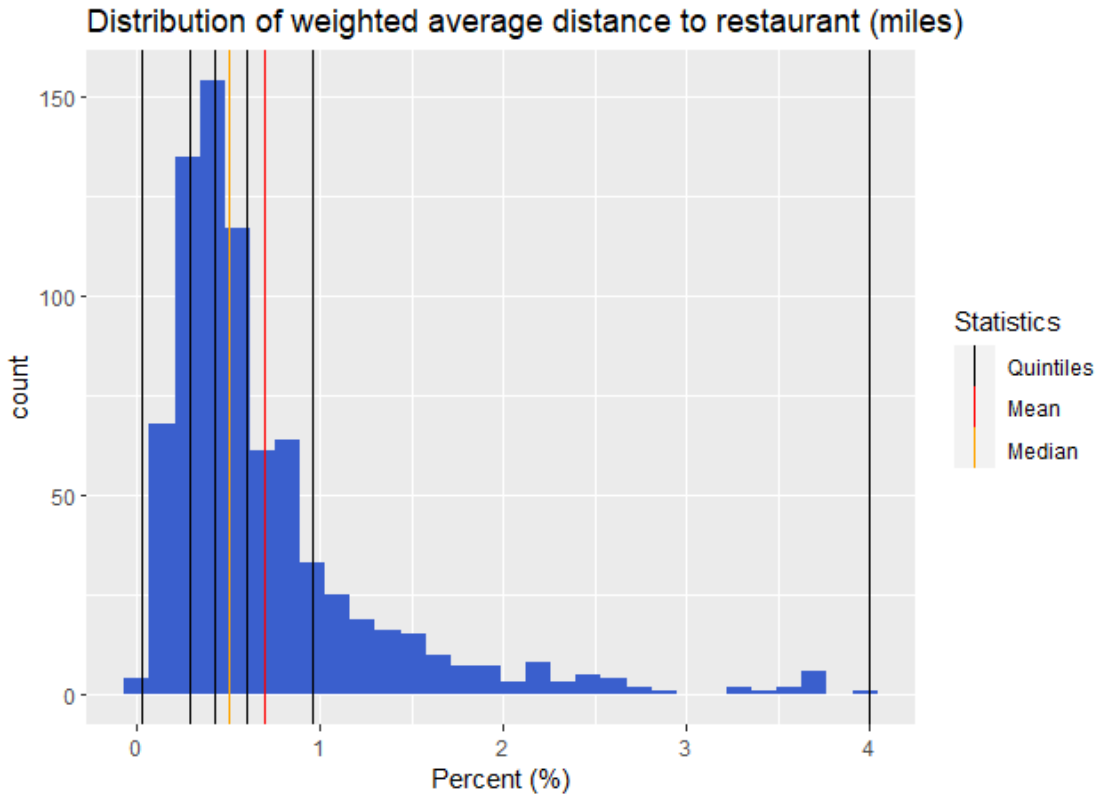
Indicator 10 – Proximity to core business

This indicator was created internally by PSRC.

Summary – Indicator 10		
Description		Proximity to supermarket/grocery: Location within ½ miles of supermarket/grocery Proximity to pharmacy Location within ¼ miles of pharmacy Proximity to restaurant/café/dinner: Location within ¼ miles of restaurant/café/dinner
Source		Google maps, PSRC
Year		2018
Proximity to supermarket/grocery		
Quintiles	0%	0.07
	20%	0.42
	40%	0.59
	60%	0.82
	80%	1.31
	100%	7.35
Classification	0	>1.20 mi
	1	0.80 – 1.20 mi
	2	0.60 – 0.80 mi
	3	0.40 – 0.60 mi
	4	<0.40 mi
Proximity to pharmacy		
Quintiles	0%	0.05
	20%	0.40
	40%	0.56
	60%	0.78
	80%	1.25
	100%	8.78
Classification	0	>1.20 mi
	1	0.80 – 1.20 mi
	2	0.60 – 0.80 mi
	3	0.40 – 0.60 mi
	4	<0.40 mi
Proximity to restaurants		
Quintiles	0%	0.03
	20%	0.28
	40%	0.42
	60%	0.60
	80%	0.95
	100%	4.00
Classification	0	>1.00 mi
	1	0.75 – 1.00 mi
	2	0.50 – 0.75 mi
	3	0.25 – 0.50 mi
	4	<0.25 mi


Distribution of weighted average distance to supermarket/grocery (miles)
count
200
150
100
50
0
0
2
4
6
Percent (%)
Statistics
Quintiles
Mean
Median

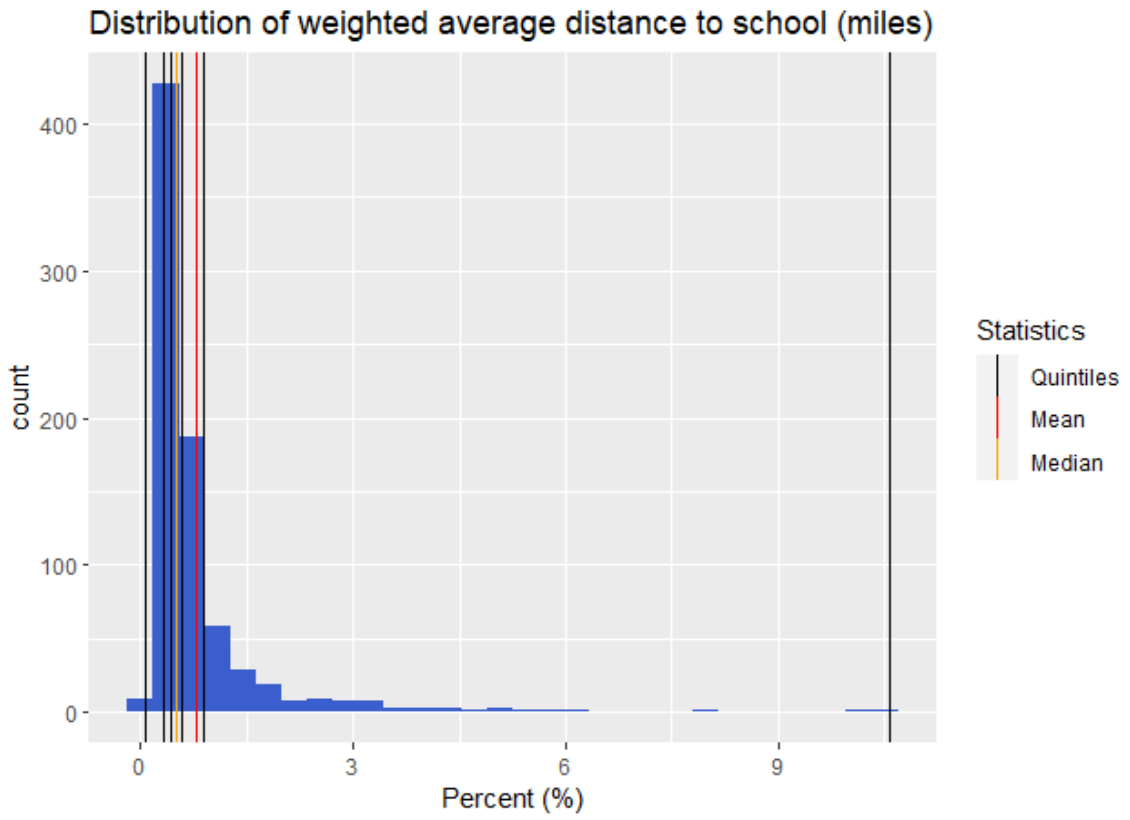

Distribution of weighted average distance to pharmacy (miles)
count
200
150
100
50
0
0.0
2.5
5.0
7.5
Percent (%)
Statistics
Quintiles
Mean
Median

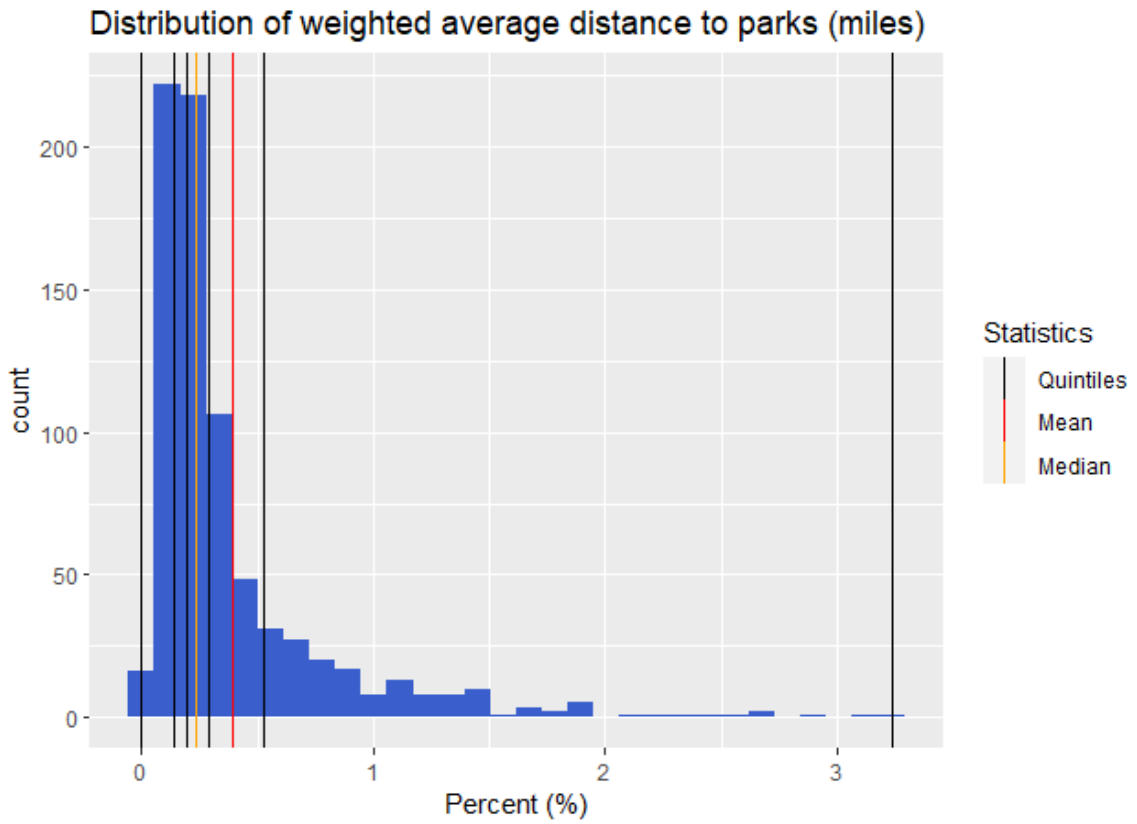

Distribution of weighted average distance to restaurant (miles)
150
100
50
0
count
0
1
2
3
4
Percent (%)
Statistics
Quintiles
Mean
Median

Indicator 11 – Proximity to civic infrastructure

This indicator was created internally by PSRC. See Y:\VISION 2050\Data\Displacement\Displacement Index 2021\docs\ByIndicator\11-Proximity to Civic Infrastructure for documentation. Note that for the 2021 update, only the "schools" portion was updated – the "parks" numbers were kept the same. Additionally, note that the scripts to process the proximity to schools indicator are the only scripts done in Python.

Summary – Indicator 11		
Description		Proximity to schools: Weighted average distance to nearest public school Proximity to parks: Weighted average distance to nearest park
Source		PSRC
Year		2018
Proximity to Schools		
Quintiles	0%	0.07
	20%	0.33
	40%	0.44
	60%	0.57
	80%	0.89
	100%	10.6
Classification	0	>1.00 mi
	1	0.80 – 1.00 mi
	2	0.60 – 0.80 mi
	3	0.40 – 0.60 mi
	4	< 0.40 mi
Proximity to parks		
Quintiles	0%	0
	20%	0.14
	40%	0.20
	60%	0.29
	80%	0.53
	100%	3.23
Classification	0	>0.60 mi
	1	0.45 – 0.60 mi
	2	0.30 – 0.45 mi
	3	0.15 – 0.30 mi
	4	<0.15 mi


Distribution of weighted average distance to school (miles)
count
400
300
200
100
0
0
3
6
9
Percent (%)
Statistics
Quintiles
Mean
Median



Indicator 12 – Proximity to high-income neighborhood

Summary – Indicator 12		
Description		Census tracts that have a median household income <80% of AMI and abut a tract where median household is >120% of AMI
Source		American Community Survey/Tidycensus
	Table	B19113
Year		2015-2019
Quintiles		Do not apply, 0 and 1 only values
Classification	0	Other tracts
	4	Census tract has a median household income <80% of AMI and abut a tract where median household is >120% of AMI

ACS table B19113 contains the median family income. This estimate was used instead of median household income because it takes into consideration household size. Additionally, CHAS uses the same value for their cost burden analysis. From table B19113 we can estimate the ratio of median household income by tract, to the median household income by county. The table has estimates and margin of errors for the following indicators:

- Median family income by county (inc_cty)

- Median family income by tract (inc_trc)

With these values, we estimated the income ratio and then classified the results by three different levels:

$$ratio = \frac{inc_trc}{inc_cty}$$

Classification	Description
$ratio \leq 0.80$	Census tract that have a median household income <= 80% of AMI
$0.80 < ratio < 1.20$	Census tract that have a median household income between 80% to 120% of AMI
$ratio \geq 1.20$	Census tract that have a median household income >= 120% of AMI

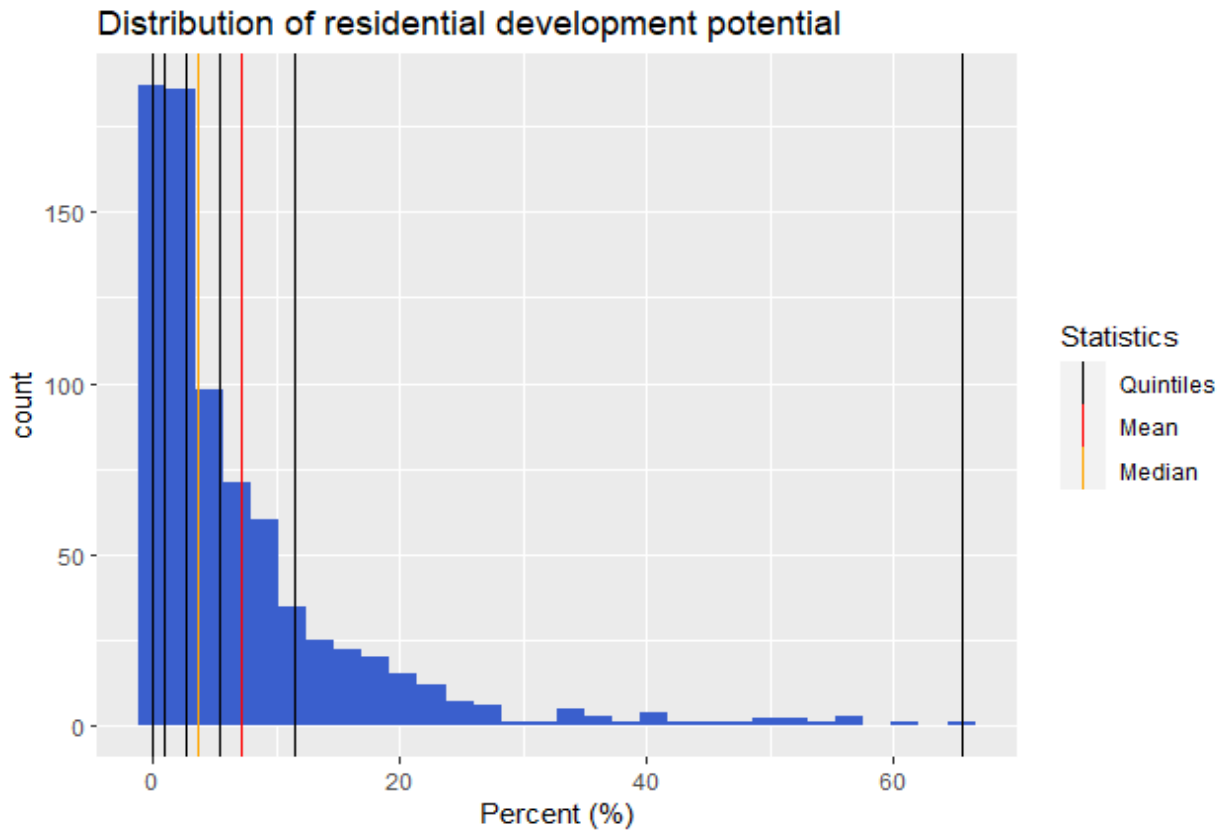
Finally, we identified tracts with an income ratio under 80% of AMI that are neighbors of tracts with an income ratio over 120% of AMI using the function st_touches() in the sf packages in R.

Classification	Number of tracts
Census tracts that have a median household income <80% of AMI and abut a tract where median household is >120% of AMI	59
Other tracts	714

Indicator 13 – Development capacity

This indicator was created internally by PSRC. See Y:\VISION 2050\Data\Displacement\Displacement Index 2021\docs\ByIndicator\DevelopmentCapacity_BY2018-2021-11-29.pdf for documentation.

Summary – Indicator 13		
Description		Residential development potential based on the difference (and percentage) between existing and zoned capacity
Source		PSRC
Year		2018 base year
Quintiles	0%	0%
	20%	1%
	40%	3%
	60%	5%
	80%	11%
	100%	65%
Classification	0	<1%
	1	1 – 4%
	2	4 – 7%
	3	7 – 10%
	4	>10%



Indicator 14 – Median rent

From ACS table B25031, we can estimate the ratio of gross median rent by tract, to the gross median rent by county. This estimation is made for different house sizes (from 0 bedrooms to 5 and more). The table has estimates and margin of errors for the following indicators:

- Gross Median Rent (GMR) – 0 bedrooms (by tract and by county)
- Gross Median Rent (GMR) – 1 bedroom (by tract and by county)
- Gross Median Rent (GMR) – 2 bedrooms (by tract and by county)
- Gross Median Rent (GMR) – 3 bedrooms (by tract and by county)
- Gross Median Rent (GMR) – 4 bedrooms (by tract and by county)
- Gross Median Rent (GMR) – +5 bedrooms (by tract and by county)

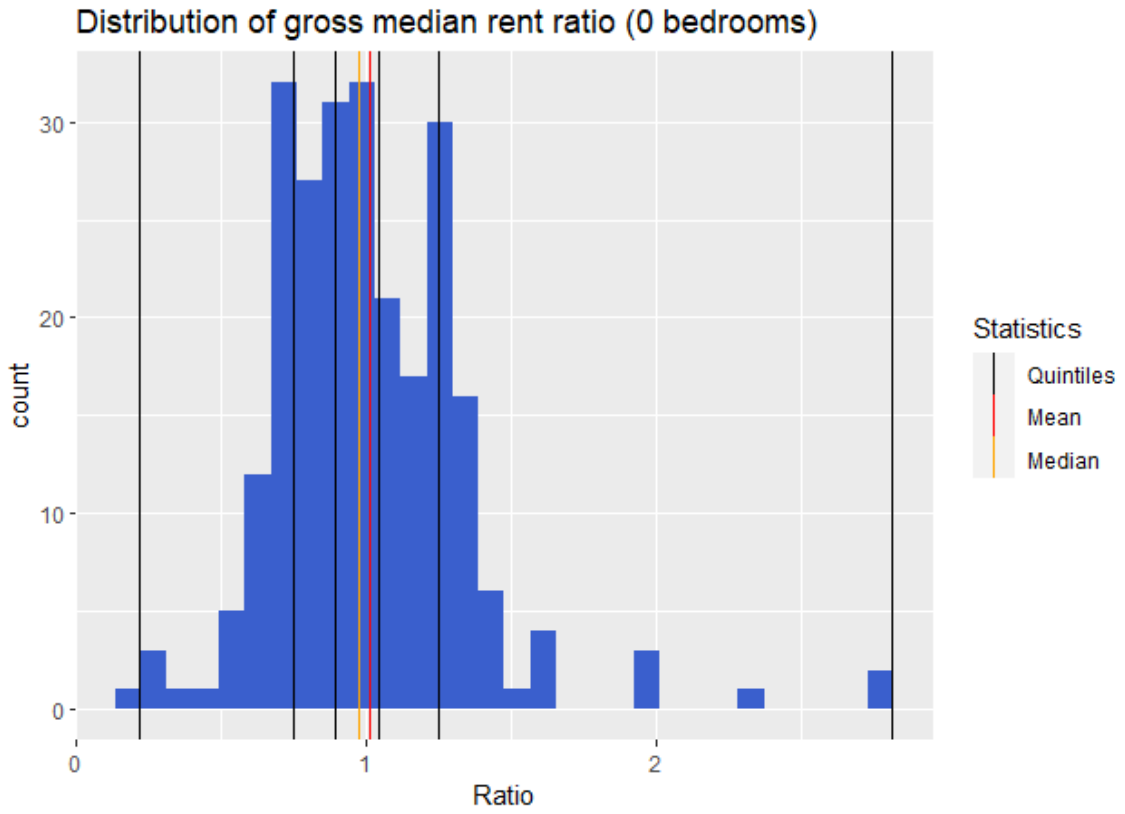
With these values, the gross median rent ratio is estimated as

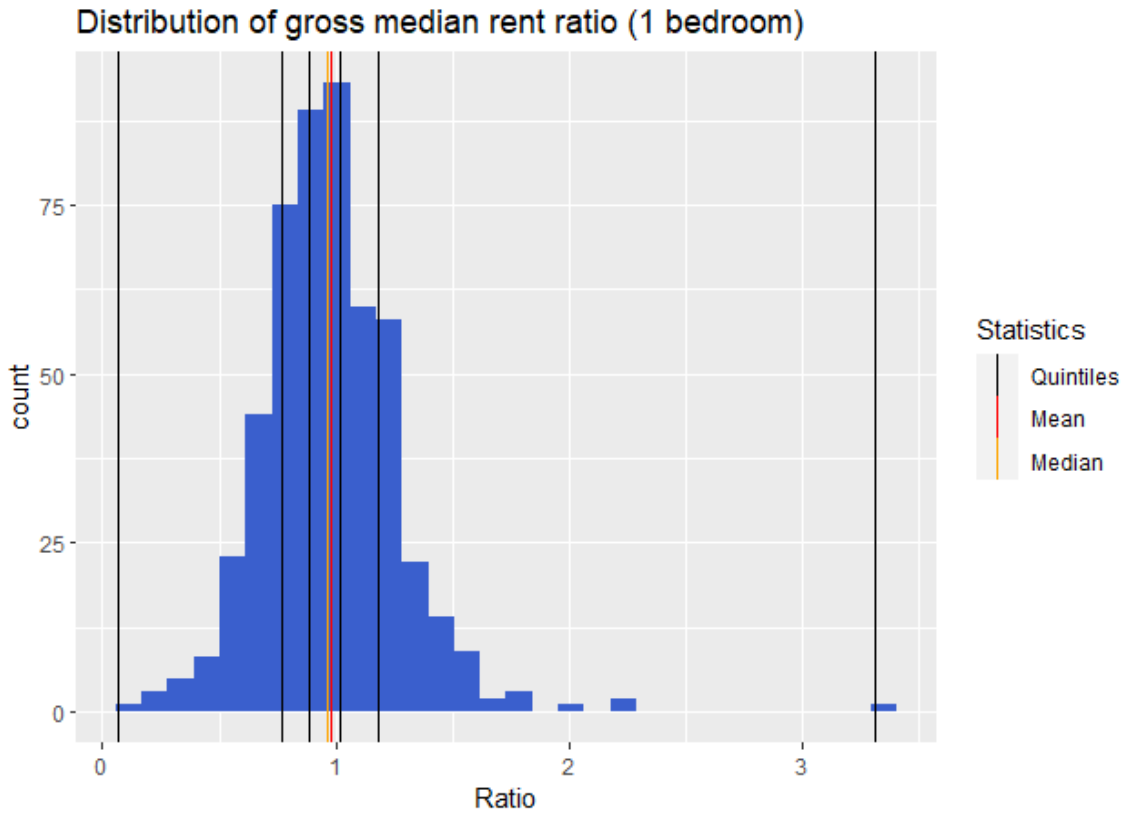
$$GMR_{ratio\ n\ bedrooms} = \frac{GMR_{tract}}{GMR_{county}}$$

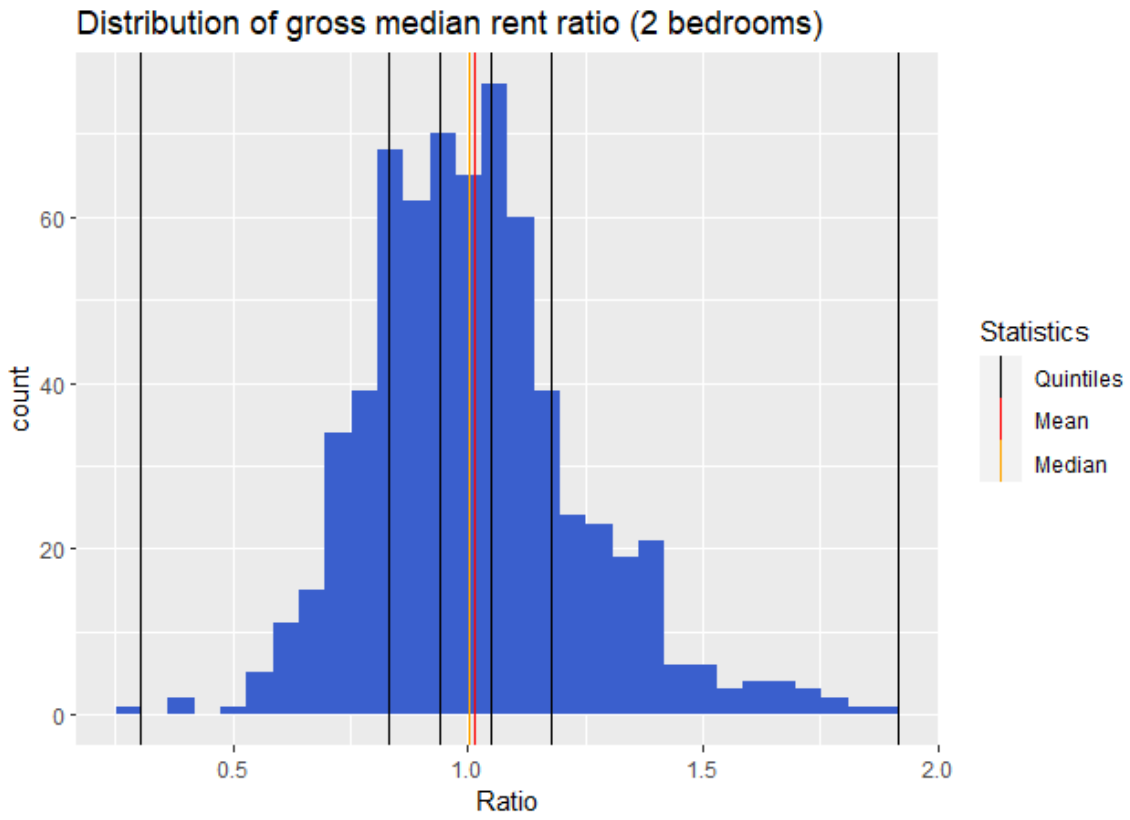
$$n = \{0, 1, 2, 3, 4, +5\}$$

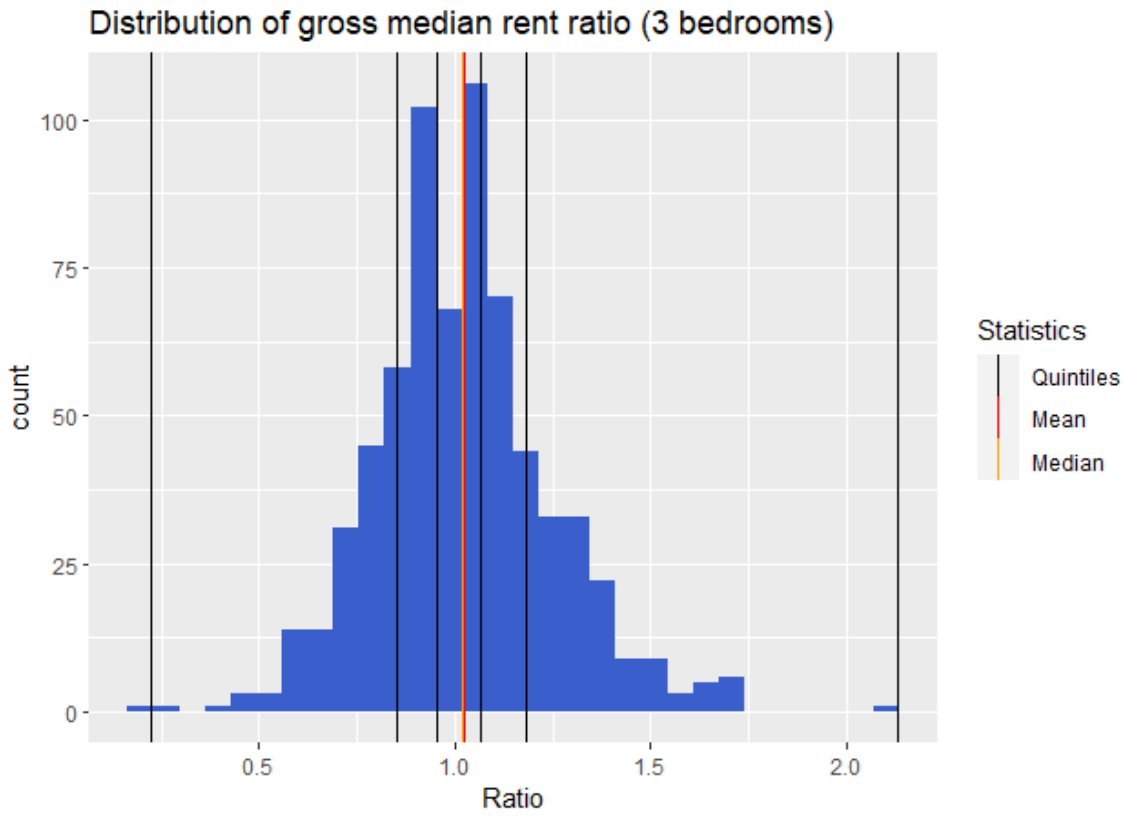
Summary – Indicator 14		
Description		Ratio of tract median gross rent to county median gross rent, by # of bedrooms
Source		American Community Survey/Tidycensus
Year		2015-2019
Gross median rent no bedrooms		
Quintiles	0%	0.22
	20%	0.75
	40%	0.89
	60%	1.04
	80%	1.25
	100%	2.81
Classification	0	<0.75
	1	0.75-0.80
	2	0.80-0.85
	3	0.85-0.90
	4	>0.90
Gross median rent 1 bedroom		
Quintiles	0%	0.07
	20%	0.77
	40%	0.89
	60%	1.02
	80%	1.19
	100%	3.31
Classification	0	<0.75
	1	0.75-0.80
	2	0.80-0.85
	3	0.85-0.90
	4	>0.90

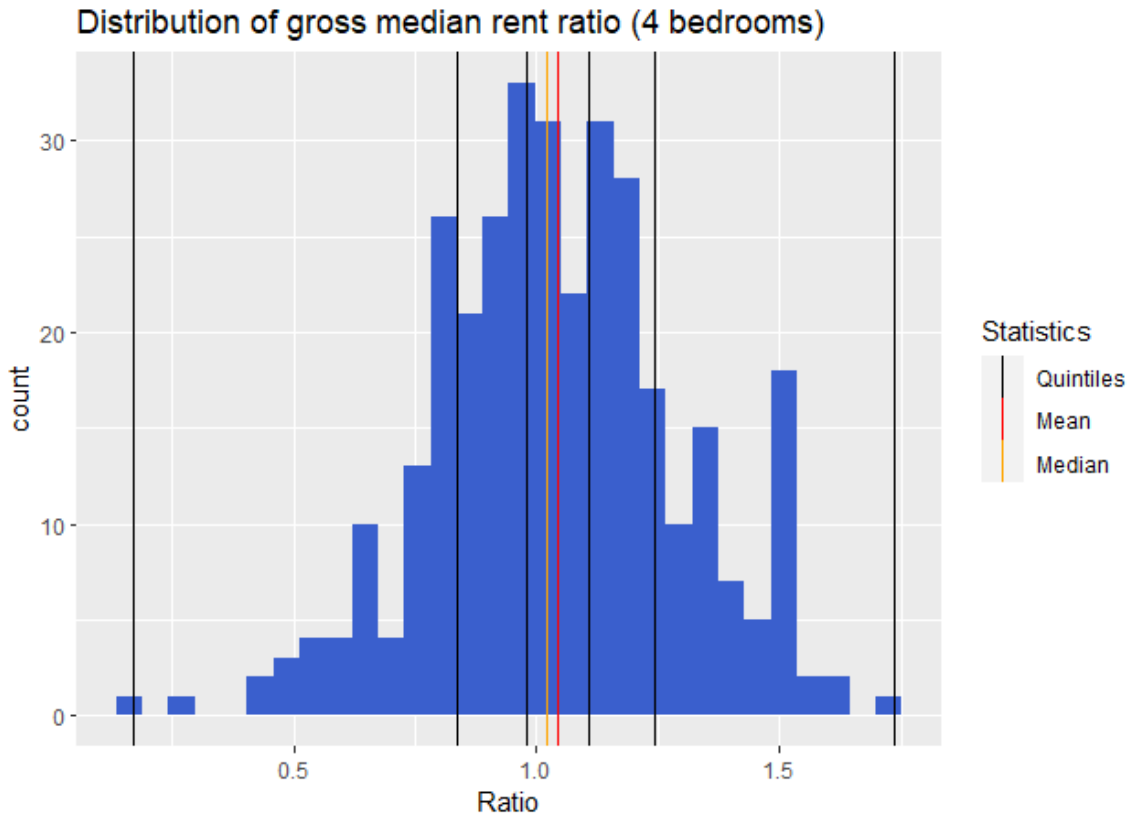
Gross median rent 2 bedrooms		
Quintiles	0%	0.30
	20%	0.83
	40%	0.94
	60%	1.05
	80%	1.18
	100%	1.92
Classification	0	<0.75
	1	0.75-0.80
	2	0.80-0.85
	3	0.85-0.90
	4	>0.90
Gross median rent 3 bedrooms		
Quintiles	0%	0.23
	20%	0.85
	40%	0.95
	60%	1.07
	80%	1.18
	100%	2.13
Classification	0	<0.75
	1	0.75-0.80
	2	0.80-0.85
	3	0.85-0.90
	4	>0.90
Gross median rent 4 bedrooms		
Quintiles	0%	0.17
	20%	0.84
	40%	0.98
	60%	1.11
	80%	1.24
	100%	1.73
Classification	0	<0.75
	1	0.75-0.80
	2	0.80-0.85
	3	0.85-0.90
	4	>0.90
Gross median rent +5 bedrooms		
Quintiles	0%	0.41
	20%	0.89
	40%	1.02
	60%	1.16
	80%	1.34
	100%	1.53
Classification	0	<0.75
	1	0.75-0.80
	2	0.80-0.85
	3	0.85-0.90
	4	>0.90

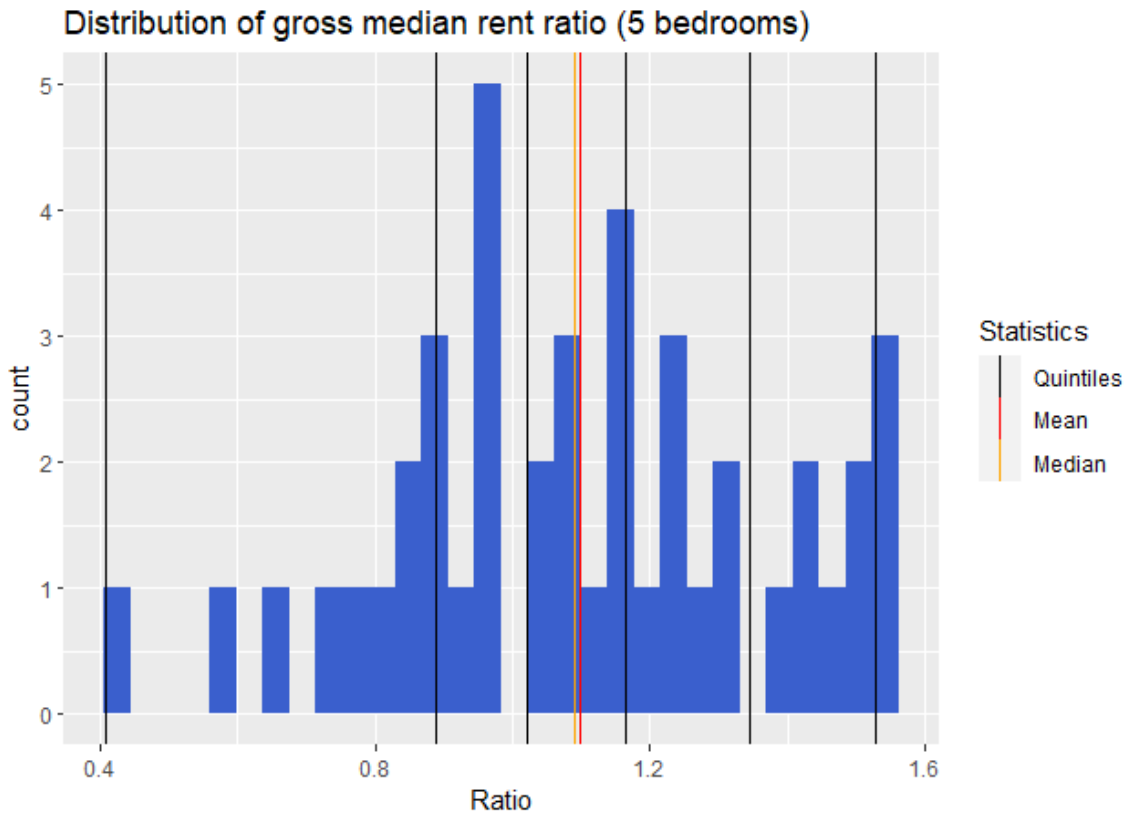

Distribution of gross median rent ratio (0 bedrooms)
count
30
20
10
0
0
1
2
Ratio
Statistics
Quintiles
Mean
Median


Distribution of gross median rent ratio (1 bedroom)
count
75
50
25
0
0
1
2
3
Ratio
Statistics
Quintiles
Mean
Median


Distribution of gross median rent ratio (2 bedrooms)
count
60
40
20
0
0.5
1.0
1.5
2.0
Ratio
Statistics
Quintiles
Mean
Median


Distribution of gross median rent ratio (3 bedrooms)
count
100
75
50
25
0
0.5
1.0
1.5
2.0
Ratio
Statistics
Quintiles
Mean
Median


Distribution of gross median rent ratio (4 bedrooms)
count
30
20
10
0
0.5
1.0
1.5
Ratio
Statistics
Quintiles
Mean
Median


Distribution of gross median rent ratio (5 bedrooms)
count
5
4
3
2
1
0
0.4
0.8
1.2
1.6
Ratio
Statistics
Quintiles
Mean
Median

Indicator 15 – Voter turnout

Calculation:

This indicator reflects the percent of all people in the tract, regardless of age or citizenship status, who voted. We use this percentage in the index to approximate civic engagement. Calculating this figure by tract requires aggregation from the precinct to the tract level using a weighted scheme.

We collect data on the number of votes cast for the 2020 Presidential election by precinct, $V_{precinct}$. We also use 2018 UrbanSim baseyear data to calculate the population in each precinct, $pop_{precinct}$. Then, for each precinct, we can calculate the precinct voter turnout, $T_{precinct}$, as

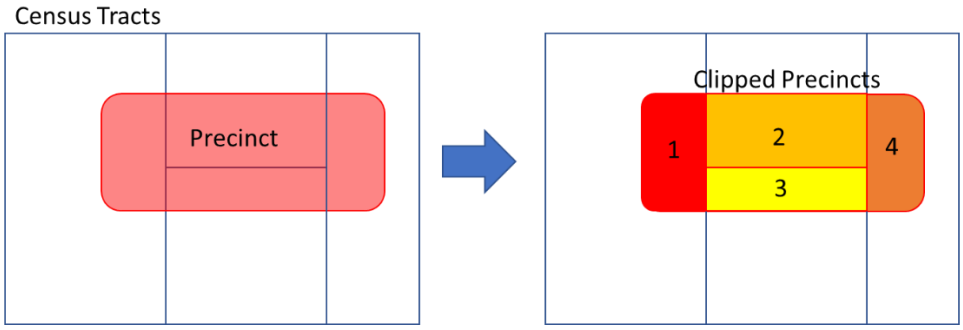
$$T_{precinct} = \frac{V_{precinct}}{pop_{precinct}}.$$

From here, for each tract we identify the precincts intersecting it and calculate the tract's turnout, T_{tract}, as a weighted sum of those precincts' turnouts. The weight for each precinct, W_i, is the percent of the tract's residential units that fall in that precinct. Thus, where i represents one of the intersecting precincts, we have

$$T_{tract} = \sum_{i \text{ in (intersecting precincts)}} W_i T_{precinct_i}$$

The steps for these calculations are

1. Download election data (.csv) and total votes cast in Presidential election by precinct, $V_{precinct}$
2. Download precinct shapefile (.shp) and join it to election data by precinct
3. Connect to the 2018_parcel_baseyear_rtp database and download "households," "buildings," and "parcels" (containing parcel centroids) datasets. Join households and buildings datasets to calculate the total population and residential units by parcel id. Join these values to parcels dataset by parcel_id.
4. Intersect parcel centroids with precinct spatial feature, then calculate the total population in the precinct, $pop_{precinct}$
5. Calculate $T_{precinct}$
6. Download tract shapefile
7. Extract the precinct features that overlay the Census tracts polygons (clip feature)



8. Intersect parcel centroids with these clipped precincts to calculate total residential units per clipped precinct, R_{CP}
9. Intersect parcel centroids with tract polygons to calculate total residential units by tract, R_{tract}
10. Calculate weight per clipped precinct,

$$W_i = \frac{R_{CP_i}}{R_{tract}}$$

11. Calculate T_{tract}

Data:

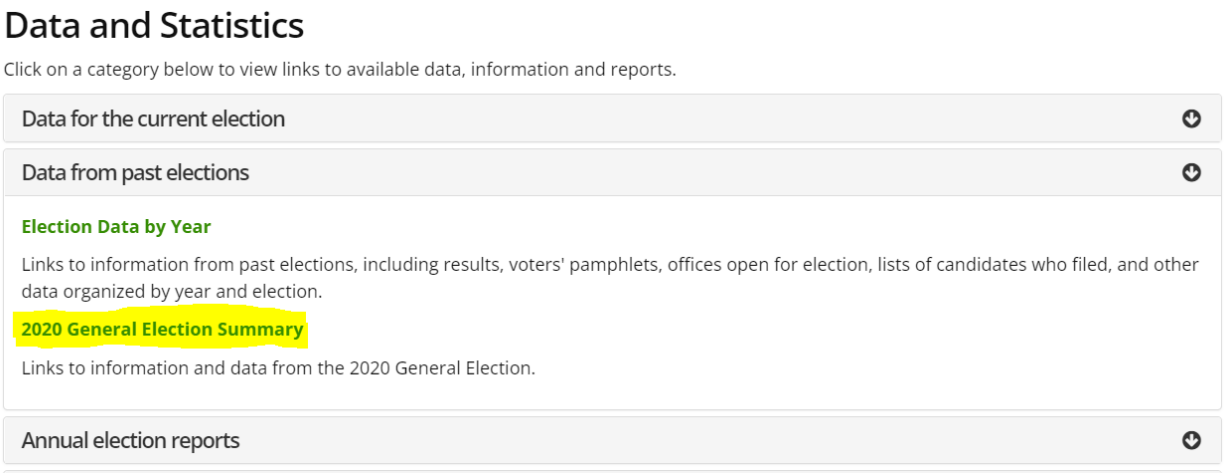
- **Population and residential units data** was downloaded from the PSRC AWS MySQL database called "2018_parcel_baseyear_rtp" using the following line in R (see R script):

```
dbConnect(

MySQL(), user='psrcurbansim', password='psrc_urbansim', dbname='2018_parcel_baseyear_rtp',
host='aws-modelmysql'

)
```

- **Elections data** was found on the Washington Secretary of State (WA SOS) [data and statistics page](#).



Navigate to "Data from past elections" > "2020 General Election Summary"

2020 General Election Summary

Quick links to information and data and from the 2020 General Election.

Where do I view results of the 2020 General Election?

2020 General Election Results

Select the tabs to navigate the results. See also current and past elections.

Post-election Audits and Voting System Tests

As with every election, we performed logic and accuracy tests prior to the 2020 General Election to ensure the accuracy of the certified vote counting equipment. In addition, we conducted post-election audits within 48 hours of Election Day.

Did you know these events are open for public observation at your local county elections office?

Voting System Testing and Certification

More information about testing, audits, and a list of certified tabulation systems in the state of Washington.

Where do I find data and other reports from the 2020 General Election?

2020 General Election Data

This page contains links to publicly available election data and information from the 2020 General Election:

- Ballot status reports
- Congressional and Legislative District reports

Click on "2020 General Election Data" then "GIS Precinct Results" under "Other Files" at the bottom of the page.

Other Files

Official Canvass of the Returns G2020_ Certification 12 01 2020.pdf

Certification of G2020 Presidential Candidates.pdf

2020 State Candidate Certification.pdf

2020 Ballot Measure Certification.pdf

Congressional District Results XLSX (PDF Version - County Part PDF Version)

Legislative District Results XLSX (PDF Version - County Part PDF Version)

2020 General Reconciliation.xlsx

GIS Ready Precinct Results

2020 Annual Report of Washington State Elections

Election data is in Sheet 1 of this Excel file. Follow R script to calculate Presidential election votes by precinct.

- **Precinct shapefiles** were found at the WA SOS data and statistics page under "Other data files and resources" > "Precinct shapefiles (2004 – 2021)", Statewide_Precincts_2020General.zip.

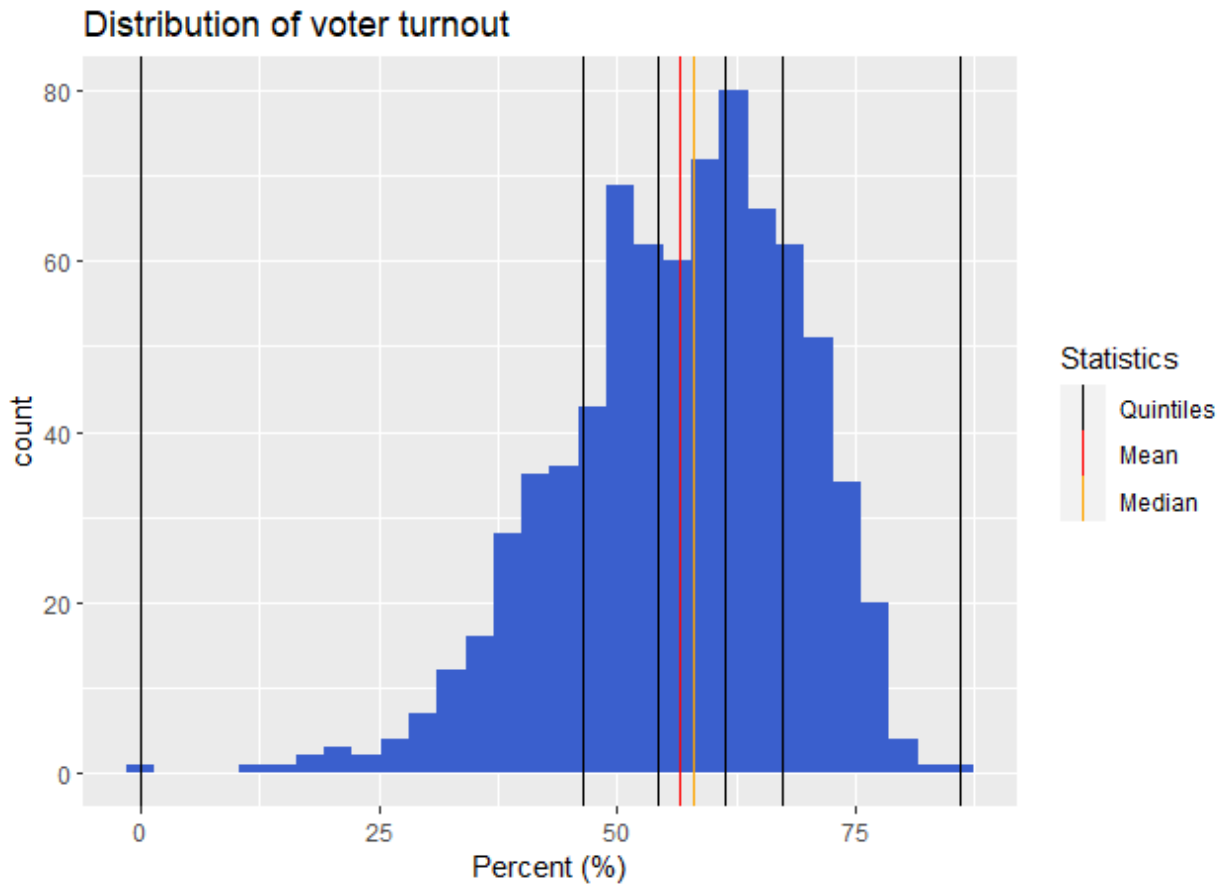
Precinct Shapefiles

2021 - Statewide_Splits_2021General.zip (Precinct Splits) Statewide_Precincts_2021General.zip (Precincts) Statewide_Precincts_2021General_consol.zip (Consolidated Results Version)

2020 - Statewide_Splits_2020General.zip (Precinct Splits) Statewide_Precincts_2020General.zip (Precincts)

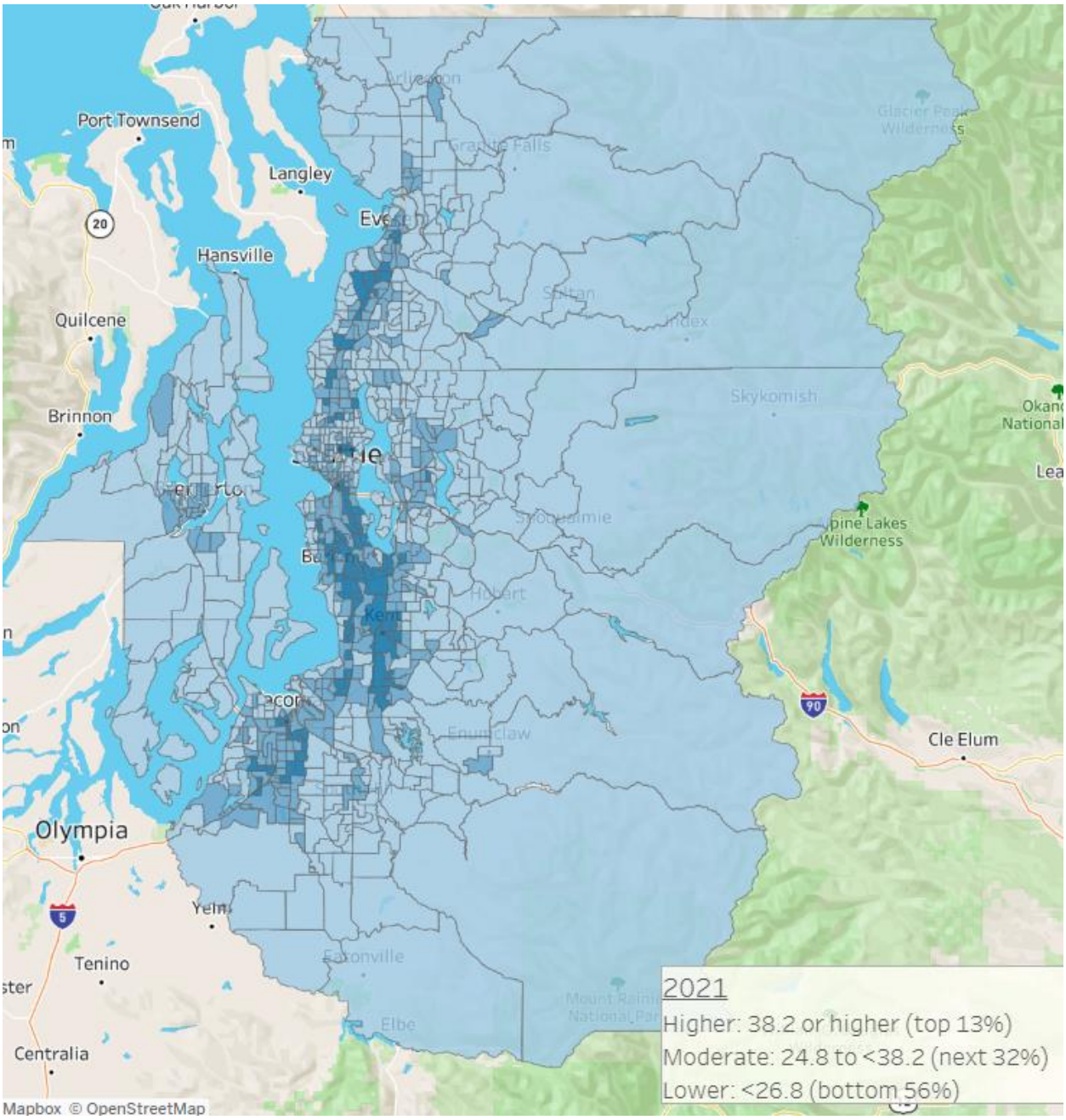
2019 - Statewide_Splits_2019General.zip (Precinct Splits) Statewide_Precincts_2019General.zip (Precincts)

Summary – Indicator 15		
Description		Percent of all population who voted in the 2020 Presidential elections
Source		American Community Survey/Tidycensus
Table		B15003
Year		2020, 2018 baseyear
Quintiles	0%	11%
	20%	47%
	40%	54%
	60%	61%
	80%	67%
	100%	86%
Classification	0	>68%
	1	61 – 68%
	2	54 – 61%
	3	47– 54%
	4	<47%



Displacement risk index analysis

The displacement risk index analysis has four main components: Classifying each indicator, merging the indicators into one dataset, estimating the displacement risk index, and assigning final categories through breakpoints. The final results for this stage are found in docs\displacement-risk-data-2021.xlsx.



Classification

After estimating the quintiles (0%, 20%, 40%, 60%, 80%, 100%) for each indicator's distribution, we classified the data into 4 risk levels (0, 1, 2 ,3 4), 0 being the lowest displacement risk and 4 the highest. The breakpoints are shown in the next table.

Indicator		Classifications				Weight	Label
		0	1	2	3	4	
People of Color			>20%	>30%	>40%	>50%	100%	% pop Non-white non-hispanic
Linguistic Isolation			>4%	>8%	>12%	>16%	100%	% pop >5 do not speak English very well
Educational Attainment			>35%	>50%	>65%	>80%	100%	% pop without bachelor's degree or higher
Housing Tenancy			>15%	>30%	>45%	>60%	100%	% hh that are renters
Cost Burden	Cost-Burdened hh		>10%	>15%	>20%	>25%	50%	% cost-burdened hh
	Severly Cost-Burdened hh		>10%	>15%	>20%	>25%	50%	% severely cost-burdened hh
Poverty Levels			>8%	>16%	>24%	>32%	100%	% pop Living below 200% of poverty Level
Jobs by Auto/transit	Jobs by auto - 30 min		>75,000	>200,000	>325,000	>450,000	50%	Jobs within 30min auto travel time
	Jobs by transit - 45 min		>1,000	>13,000	>43,000	>200,000	50%	Jobs within 45min transit travel time
Proximity to Transit 2017 - pop			>6%	>24%	>42%	>60%	100%	% pop near current transit
Proximity to Transit 2025 - area			>6%	>24%	>42%	>60%	100%	% area near future transit
Proximity Core Business	Pharmacy		1.20	0.80	0.60	0.40	33%	Weighted average distance to pharmacy (mi)
	Supermarket		1.20	0.80	0.60	0.40	33%	Weighted average distance to supermarket (mi)
	Restaurant		1.00	0.75	0.50	0.25	33%	Weighted average distance to restaurant (mi)
Proximity Civic Infrastructure	Park		0.60	0.45	0.30	0.15	50%	Weighted average distance to park (mi)
	School		1.00	0.80	0.60	0.40	50%	Weighted average distance to school (mi)
Proximity to High-Income Neighborhood	MFI							Tract median family income
	MFI / County MFI							Tract median family income / Couny mfi
	Proximity					1	100%	Proximity to high income tract
Development Capacity			>1%	>4%	>7%	>10%	100%	% at risk
Median Gross Rent	Tract MGR / County MGR						Variable	Ratio tract median gross rent to county median gross rent
	Tract MGR / County MGR (0 room)		0.90	0.85	0.80	0.75		No room
	Tract MGR / County MGR (1 room)		0.90	0.85	0.80	0.75		1 room
	Tract MGR / County MGR (2 rooms)		0.90	0.85	0.80	0.75		2 rooms
	Tract MGR / County MGR (3 rooms)		0.90	0.85	0.80	0.75		3 rooms
	Tract MGR / County MGR (4 rooms)		0.90	0.85	0.80	0.75		4 rooms
	Tract MGR / County MGR (5 rooms)		0.90	0.85	0.80	0.75		5+ rooms
Voter Turnout			68%	61%	54%	47%	100%	% pop >=18 who voted

The breakpoints were set by considering the exact quintiles, then finding evenly spaced breakpoints that most closely matched those quintiles. This was done for easier interpretation by users. The table above is found on Sheet 1 of the final results file.

Merging

The second step in the analysis is merging the different indicator datasets into one. This master dataset is organized with the following columns:

Census tract ID (GEOID)	Proximity to core business (supermarket/grocery) – classification
People of color –classification	Proximity to core business (pharmacy) – classification
Linguistic Isolation – classification	Proximity to core business (restaurant) – classification
Educational attainment – classification	Proximity to civic infrastructure (park) – classification
Housing tenancy – classification	Proximity to civic infrastructure (school) – classification
Cost-burdened households – classification	Proximity to high income neighborhood - classification
Severely cost-burdened households – classification	Development Capacity – classification
Household income – classification	Gross median rent (0 bedrooms) – classification
Proximity to job center by auto – classification	Gross median rent (1 bedroom) - classification
Proximity to job center by transit – classification	Gross median rent (2 bedrooms) - classification
Proximity to transit – classification	Gross median rent (3+ bedrooms) - classification*
Proximity to current or future link light rail and streetcar	Voter turnout – classification

* Note that due to the scarcity of homes with more than three rooms, these categories were collapsed to only retain a category containing all homes with 3+ rooms.

In the 2021 update, much of this work was done manually in Excel. However, some files from the 2018 update automate the process. Y:\VISION 2050\Data\Displacement\Displacement_Risk_Script\src\ Results_DisplacementRisk_polygon.R is a script to merge all indicator values into one, and likely includes code to create classification columns. Updating this 2018 script would be more efficient for summarizing, as little has to be done manually in Excel.

For the 2021 update, the first lines of the file scripts\consolidateFinalValues.R merge all indicator values into one dataset and save it as data\FinalIndicators.xlsx. However, this script does not create the

classification columns. One must copy this new FinalIndicators.xlsx dataset into Sheet 2 of the final results file and reformat the columns. Additionally, classification columns must be created for each indicator by creating Excel formulas encoding the breakpoints and referencing the raw values for each indicator.

The remaining lines in consolidateFinalValues.R create various plots for all indicators in one pass and can be ignored at this time.

Estimation

Once the final displacement risk database is compiled, we can estimate the risk index. The weights for each indicator are shown in the previous table. Weights are 100% for each indicator having only one level. If an indicator has more than one level, we split the weight evenly across levels. For the indicator 14 (median rent), the weight is not fixed, as not all tracts have gross median rent for all housing types (0-bedroom, 1-bedroom, etc.) This prevents us from having a constant weighting scheme across all tracts. Instead, we used a weight based on the information available in each tract. For example, if tract X has gross median rent for housing with 0, 1 and 2 bedrooms, the weight for each median rent score in that tract is 1/3. On the other hand, if tract Y has gross median rent for housing with 0 and 1 bedroom, the weight is 1/2 for each median rent score. Like "Merging," the 2021 work on this step was done manually in Excel. However, the script Y:\VISION 2050\Data\Displacement\Displacement_Risk_Script\Results_Classification.R could be updated to automate this process.

Finally, the displacement risk index for each census tract is estimated as:

$$Risk\ index = \sum_{i=1}^{n=indicators} indicator_i * weight_{indicator_i}$$

The index ranges from 0 to 53, being 0 a census tract with no displacement risk and 53 a tract with the highest risk.

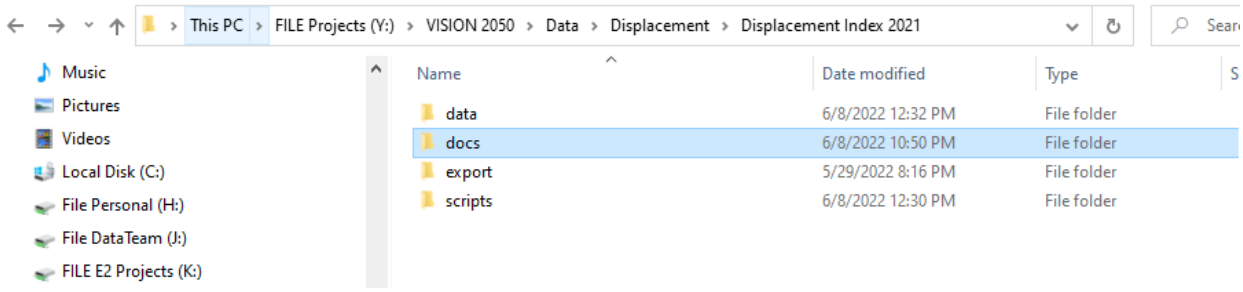
Assignment to final categories using breakpoints

We classify the displacement risk scores into three levels: Highest risk, moderate risk, and lower risk. Whereas in the 2018 displacement risk project these groups were based on percentile cutoffs, in the 2021 update we instead retained the same cutoff values as in the previous project iteration, regardless of percentile. This choice was made so users could compare displacement risk scores across years, knowing they were based on the same rating scale. The cutoffs are:

Highest risk	> 38.6
Moderate risk	< 38.6, > 24.8
Lower risk	< 24.8

Appendix

The data, scripts, and results are in the Y:\VISION 2050\Data\Displacement\Displacement Index 2021 folder. The files are organized into four main folders: data, docs, export, and scripts.



1. Data

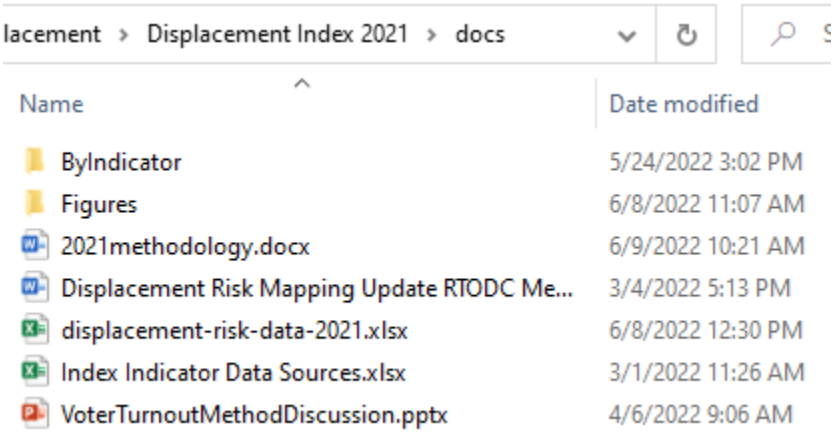
   This folder contains raw data collected from several sources along with the clean data. Each indicator has a separate folder containing the relevant datasets.



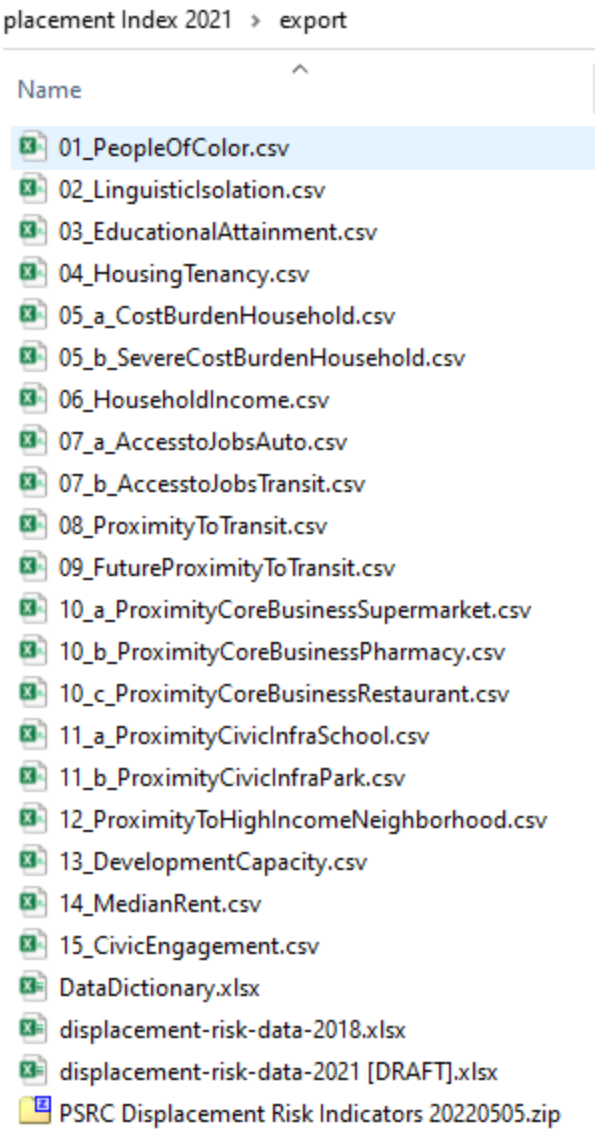
   Within each indicator folder, clean data either follows the pattern

[indicator number]_[IndicatorName].csv (values) or starts with “tract” (values including tract shapefiles). Raw data, when available (some indicators download data using R packages and no raw dataset is explicitly generated), follows name patterns other than the two just mentioned.

2. docs
   This folder contains general documentation (such as this methodology document), documentation pertaining to specific indicators (ByIndicator folder), and figures generated throughout the 2021 update process (Figures). The final index values for all tracts are found in displacement-risk-data-2021.xlsx.



3. export
   This folder was generated to send externally when users request the displacement risk index data. It contains every indicator’s clean data file along with the published 2018 final index calculation spreadsheet and the DRAFT 2021 final index calculation spreadsheet.



4. scripts
   This folder contains all scripts used throughout the 2021 update. Each indicator has a separate folder containing relevant scripts, and there are a few unfiled scripts that are more general. In general, each indicator has a file following the pattern
   "DataGen_[indicator number]_[IndicatorName].R"
   which generates the values for the given indicator and another following the pattern
   "Vis_[indicator number]_[IndicatorName].R"
   which generates various visualizations for that indicator, and which vary by indicator and the questions the team asked at that stage of the update process.


splacement Index 2021 › scripts
Name
01-People of Color
02-Linguistic Isolation
03-Educational Attainment
04-Housing Tenancy
05-Cost Burden
06-Household Income
07-Access to Jobs
08-Proximity to Transit
09-Proximity to Current or Future hct
10-Proximity to Core Business
11-Proximity to Civic Infrastructure
12-Proximity to High Income Neighborhood
13-Development Capacity
14-Median Rent
15-Voter Turnout
consolidateFinalValues.R
schools_displ_index.R
Viz_10_CoreBusiness.R