Package 'ndi'

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Title Neighborhood Deprivation Indices

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Description Computes various geospatial indices of socioeconomic deprivation and disparity in the United States. Some indices are considered ``spatial'' because they consider the values of neighboring (i.e., adjacent) census geographies in their computation, while other indices are ``aspatial'' because they only consider the value within each census geography. Two types of aspatial neighborhood deprivation indices (NDI) are available, including: (1) based on Messer et al. (2006) <doi:10.1007/s11524-006-9094-x> and (2) based on Andrews et al. (2020) <doi:10.1080/17445647.2020.1750066> and Slotman et al. (2022) <doi:10.1016/j.dib.2022.108002> who use variables chosen by Roux and Mair (2010) <doi:10.1111/j.1749-6632.2009.05333.x>. Both are a decomposition of multiple demographic characteristics from the U.S. Census Bureau American Community Survey 5-year estimates (ACS-5; 2006-2010 onward). Using data from the ACS-5 (2005-2009 onward), the package can also compute indices of racial or ethnic residential segregation, including but limited to those discussed in Massey & Denton (1988) <doi:10.1093/sf/67.2.281>, and additional indices of socioeconomic disparity.

License Apache License (>= 2.0)

Encoding UTF-8

LazyData true

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Depends R (>= 3.5.0)

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Suggests DescTools, ggplot2, testthat, R.rsp, spelling, usethis

VignetteBuilder R.rsp

Language en-US

URL https://github.com/idblr/ndi

BugReports https://github.com/idblr/ndi/issues

NeedsCompilation no

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Contents

anthopolos *Racial Isolation Index based on Anthopolos et al. (2011)*

Description

Compute the spatial Racial Isolation Index (Anthopolos) of selected subgroup(s).

Usage

```
anthopolos(
  geo = "tract",
  year = 2020,
  subgroup,
  crs = "ESRI:102008",
  quiet = FALSE,
  ...
)
```

Arguments

geo	Character string specifying the geography of the data either counties `geo = 'county'`, census tracts `geo = 'tract'` (the default), or census block groups `geo = 'cbg'`.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the racial or ethnic subgroup(s). See Details for available choices.
crs	Numeric or character string specifying the coordinate reference system to compute the distance-based metric. The default is Albers North America `crs = 'ESRI:102008'`.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to `get_acs` to select state, county, and other arguments for census characteristics

Details

This function will compute the spatial Racial Isolation Index (*RI*) of U.S. census tracts or counties for a specified geographical extent (e.g., the entire U.S. or a single state) based on Anthopolos et al. (2011) doi:10.1016/j.sste.2011.06.002 who originally designed the metric for the racial isolation of non-Hispanic Black individuals. This function provides the computation of *RI* for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the `get_acs` function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the geospatial computation. The yearly estimates are available for 2009 onward when ACS-5 data are available but are available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino `'NHoL'`
- **B03002_003**: not Hispanic or Latino, white alone`'NHoLW'`
- **B03002_004**: not Hispanic or Latino, Black or African American alone `'NHoLB'`
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone `'NHoLAIAN'`
- **B03002_006**: not Hispanic or Latino, Asian alone `'NHoLA'`
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'NHoLNHOPI'`
- **B03002_008**: not Hispanic or Latino, Some other race alone `'NHoLSOR'`
- **B03002_009**: not Hispanic or Latino, Two or more races `'NHoLTOMR'`
- **B03002_010**: not Hispanic or Latino, Two races including Some other race `'NHoLTRiSOR'`
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output. NOTE: Current version does not correct for edge effects (e.g., census geographies along the specified spatial extent border, coastline, or U.S.-Mexico / U.S.-Canada border) may have few neighboring census geographies, and *RI* values in these census geographies may be unstable. A stop-gap solution for the former source of edge effect is to compute the *RI* for neighboring census geographies (i.e., the states bordering a study area of interest) and then use the estimates of the study area of interest.

A census geography (and its neighbors) that has nearly all of its population who identify with the specified race or ethnicity subgroup(s) (e.g., non-Hispanic or Latino, Black or African American alone) will have an *RI* value close to 1. In contrast, a census geography (and its neighbors) that has nearly none of its population who identify with the specified race or ethnicity subgroup(s) (e.g., not non-Hispanic or Latino, Black or African American alone) will have an *RI* value close to 0.

Value

An object of class 'list'. This is a named list with the following components:

`ri` An object of class 'tbl' for the GEOID, name, *RI*, and raw census values of specified census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *RI*.

References

Anthopolos, R, James, SA, Gelfand, AE, & Miranda, ML (2011) A Spatial Measure of Neighborhood Level Racial Isolation Applied to Low Birthweight, Preterm Birth, and Birthweight in North Carolina. *Spatial and Spatio-temporal Epidemiology*, 2(4):235-246. doi:10.1016/j.sste.2011.06.002

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Other isolation indices: `bemanian_beyer`, `lieberson`, `morgan_massey`, `white`

Interaction indices: `bell`, `morgan_denton`

Education Isolation Index: `bravo`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Racial Isolation Index (a measure of isolation)
  ## of Black populations
  ## in census tracts of Georgia, U.S.A. (2020)
  anthopolos(
    geo = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = c('NHoLB', 'HoLB')
   )


## End(Not run)
```

`atkinson` *Atkinson Index based on Atkinson (1970)*

Description

Compute the aspatial Atkinson Index of income or selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
atkinson(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  epsilon = 0.5,
```

```
  holder = FALSE,
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties geo_large = 'county'.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts geo_small = 'tract'.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the income or racial or ethnic subgroup(s) as the comparison population. See Details for available choices.
epsilon	Numerical. Shape parameter that denotes the aversion to inequality. Value must be between 0 and 1.0 (the default is 0.5).
holder	Logical. If TRUE, will compute index using the Hölder mean. If FALSE, will not compute with the Hölder mean. The default is FALSE.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Atkinson Index (*A*) of income or selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Atkinson (1970) doi:10.1016/00220531(70)900396. This function provides the computation of *A* for median household income and any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the aspatial computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for geo_large = 'cbsa' and 2011 onward for geo_large = 'place', geo_large = 'csa', or geo_large = 'metro') but may be available from other U.S. Census Bureau surveys. When subgroup = 'MedHHInc', the metric will be computed for median household income ('B19013_001') using the Hölder mean. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino 'NHoL'
- **B03002_003**: not Hispanic or Latino, white alone 'NHoLW'
- **B03002_004**: not Hispanic or Latino, Black or African American alone 'NHoLB'
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone 'NHoLAIAN'

- **B03002_006**: not Hispanic or Latino, Asian alone `'NHoLA'`
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'NHoLNHOPI'`
- **B03002_008**: not Hispanic or Latino, Some other race alone `'NHoLSOR'`
- **B03002_009**: not Hispanic or Latino, Two or more races `'NHoLTOMR'`
- **B03002_010**: not Hispanic or Latino, Two races including Some other race `'NHoLTRiSOR'`
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

A is a measure of the evenness of residential inequality (e.g., racial or ethnic segregation) when comparing smaller geographical units to larger ones within which the smaller geographical units are located. *A* can range in value from 0 to 1 with smaller values indicating lower levels of inequality (e.g., less segregation).

The `epsilon` argument that determines how to weight the increments to inequality contributed by different proportions of the Lorenz curve. A user must explicitly decide how heavily to weight smaller geographical units at different points on the Lorenz curve (i.e., whether the index should take greater account of differences among units of over- or under-representation). The `epsilon` argument must have values between 0 and 1.0. For `0 <= epsilon < 0.5` or less 'inequality-averse,' smaller geographical units with a subgroup proportion smaller than the subgroup proportion of the larger geographical unit contribute more to inequality ('over-representation'). For `0.5 < epsilon <= 1.0` or more 'inequality-averse,' smaller geographical units with a subgroup proportion larger than the subgroup proportion of the larger geographical unit contribute more to inequality ('under-representation'). If `epsilon = 0.5` (the default), units of over- and under-representation contribute equally to the index. See Section 2.3 of Saint-Jacques et al. (2020) doi:10.48550/arXiv.2002.05819 for one method to select `epsilon`.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups

`geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *A* value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *A* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *A* computation.

Value

An object of class 'list'. This is a named list with the following components:

`a` An object of class 'tbl' for the GEOID, name, and *A* at specified larger census geographies.

`a_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *A*.

References

Atkinson, AB (1970) On the Measurement of Inequality. *Journal of Economic Theory*, 2(3):244-263. doi:10.1016/00220531(70)900396

James, D, & Taeuber, KE (1985) Measures of Segregation. *Sociological Methodology*, 15:1-32. doi:10.2307/270845

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Other one-group evenness indices: `gini`, `james_taeuber`, `sudano`, `theil`

Between groups dissimilarity indices: `duncan`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Atkinson Index (a measure of the evenness)
  ## of Black populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  atkinson(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = c('NHoLB', 'HoLB')
  )
```

```
# Atkinson Index (a measure of the evenness)
## of median household income
## in census tracts within counties of Georgia, U.S.A. (2020)
atkinson(
  geo_large = 'county',
  geo_small = 'tract',
  state = 'GA',
  year = 2020,
  subgroup = 'MedHHInc'
)


## End(Not run)
```

`bell` *Interaction Index based on Shevky & Williams (1949) and Bell (1954)*

Description

Compute the aspatial Interaction Index (Bell) of a selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
bell(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  subgroup_ixn,
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

`geo_large`	Character string specifying the larger geographical unit of the data. The default is counties `geo_large = 'county'`.
`geo_small`	Character string specifying the smaller geographical unit of the data. The default is census tracts `geo_small = 'tract'`.
`year`	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
`subgroup`	Character string specifying the racial or ethnic subgroup(s). See Details for available choices.

subgroup_ixn	Character string specifying the racial or ethnic subgroup(s) as the interaction population. If the same as subgroup, will compute the simple isolation of the group. See Details for available choices.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Interaction Index (*xPy**) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Shevky & Williams (1949; ISBN-13:978-0-837-15637-8) and Bell (1954) doi:10.2307/2574118. This function provides the computation of *xPy** for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the aspatial computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for geo_large = 'cbsa' and 2011 onward for geo_large = 'place', geo_large = 'csa', or geo_large = 'metro') but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino 'NHoL'
- **B03002_003**: not Hispanic or Latino, white alone 'NHoLW'
- **B03002_004**: not Hispanic or Latino, Black or African American alone 'NHoLB'
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone 'NHoLAIAN'
- **B03002_006**: not Hispanic or Latino, Asian alone 'NHoLA'
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone 'NHoLNHOPI'
- **B03002_008**: not Hispanic or Latino, Some other race alone 'NHoLSOR'
- **B03002_009**: not Hispanic or Latino, Two or more races 'NHoLTOMR'
- **B03002_010**: not Hispanic or Latino, Two races including Some other race 'NHoLTRiSOR'
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races 'NHoLTReSOR'
- **B03002_012**: Hispanic or Latino 'HoL'
- **B03002_013**: Hispanic or Latino, white alone 'HoLW'
- **B03002_014**: Hispanic or Latino, Black or African American alone 'HoLB'
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone 'HoLAIAN'
- **B03002_016**: Hispanic or Latino, Asian alone 'HoLA'
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone 'HoLNHOPI'
- **B03002_018**: Hispanic or Latino, Some other race alone 'HoLSOR'

- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

*xPy** is some measure of the probability that a member of one subgroup(s) will meet or interact with a member of another subgroup(s) with higher values signifying higher probability of interaction (less isolation). *xPy** can range in value from 0 to 1.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *xPy** value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *xPy** computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *xPy** computation.

Value

An object of class 'list'. This is a named list with the following components:

`xpy_star` An object of class 'tbl' for the GEOID, name, and *xPy** at specified larger census geographies.

`xpy_star_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *xPy**.

References

Eshref, S, & Williams, M (1949). *The Social Areas of Los Angeles: Analysis and Typology*. 1st Ed. Los Angeles:John Randolph Haynes and Dora Haynes Foundation. ISBN-13:978-0-837-15637-8

Bell, W (1954) A probability model for the measurement of ecological segregation. *Social Forces*, 32(4):357-364. doi:10.2307/2574118

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

See Also

get_acs for additional arguments for geographic extent selection (i.e., state and county).

Other interaction indices: morgan_denton

Isolation indices: anthopolos, bemanian_beyer, lieberson, morgan_massey, white

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Interaction Index (a measure of exposure)
  ## of non-Hispanic Black vs. non-Hispanic white populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  bell(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = 'NHoLB',
    subgroup_ixn = 'NHoLW'
   )


## End(Not run)
```

---

bemanian_beyer *Local Exposure and Isolation based on Bemanian & Beyer (2017)*

Description

Compute the aspatial Local Exposure and Isolation (Bemanian & Beyer) of a selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
bemanian_beyer(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  subgroup_ixn,
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties geo_large = 'county'.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts geo_small = 'tract'.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the racial or ethnic subgroup(s). See Details for available choices.
subgroup_ixn	Character string specifying the racial or ethnic subgroup(s) as the interaction population. If the same as subgroup, will compute the simple isolation of the group. See Details for available choices.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Local Exposure and Isolation (*LEx/Is*) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Bemanian & Beyer (2017) doi:10.1158/10559965.EPI160926. This function provides the computation of *LEx/Is* for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the aspatial computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for geo_large = 'cbsa' and 2011 onward for geo_large = 'place', geo_large = 'csa', or geo_large = 'metro') but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino 'NHoL'
- **B03002_003**: not Hispanic or Latino, white alone 'NHoLW'
- **B03002_004**: not Hispanic or Latino, Black or African American alone 'NHoLB'
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone 'NHoLAIAN'
- **B03002_006**: not Hispanic or Latino, Asian alone 'NHoLA'
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone 'NHoLNHOPI'
- **B03002_008**: not Hispanic or Latino, Some other race alone 'NHoLSOR'
- **B03002_009**: not Hispanic or Latino, Two or more races 'NHoLTOMR'
- **B03002_010**: not Hispanic or Latino, Two races including Some other race 'NHoLTRiSOR'

- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

LEx/Is is a measure of the probability that two individuals living within a specific smaller geographical unit (e.g., census tract) of either different (i.e., exposure) or the same (i.e., isolation) racial or ethnic subgroup(s) will interact, assuming that individuals within a smaller geographical unit are randomly mixed. *LEx/Is* is standardized with a logit transformation and centered against an expected case that all races or ethnicities are evenly distributed across a larger geographical unit. (Note: will adjust data by 0.025 if probabilities are zero, one, or undefined. The output will include a warning if adjusted. See `logit` for additional details.)

LEx/Is can range from negative infinity to infinity. If *LEx/Is* is zero then the estimated probability of the interaction between two people of the given subgroup(s) within a smaller geographical unit is equal to the expected probability if the subgroup(s) were perfectly mixed in the larger geographical unit. If *LEx/Is* is greater than zero then the interaction is more likely to occur within the smaller geographical unit than in the larger geographical unit, and if *LEx/Is* is less than zero then the interaction is less likely to occur within the smaller geographical unit than in the larger geographical unit. Note: the exponentiation of each *LEx/Is* results in the odds ratio of the specific exposure or isolation of interest in a smaller geographical unit relative to the larger geographical unit.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *LEx/Is* value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *LEx/Is* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *LEx/Is* computation.

Value

An object of class 'list'. This is a named list with the following components:

`lexis` An object of class 'tbl' for the GEOID, name, and *LEx/Is* at specified smaller census geographies.

`lexis_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *LEx/Is*.

References

Bemanian, A, & Beyer, KMM (2017) Measures Matter: The Local Exposure/Isolation (LEx/Is) Metrics and Relationships between Local-Level Segregation and Breast Cancer Survival. *Cancer Epidemiology, Biomarkers & Prevention*, 26(4):516-524. doi:10.1158/10559965.EPI160926

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Other isolation indices: `anthopolos`, `lieberson`, `morgan_massey`, `white`

Interaction indices: `bell`, `morgan_denton`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Local Exposure and Isolation
  ## of non-Hispanic Black vs. non-Hispanic white populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  bemanian_beyer(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = 'NHoLB',
    subgroup_ixn = 'NHoLW'
   )


## End(Not run)
```

bravo *Educational Isolation Index based on Bravo et al. (2021)*

Description

Compute the spatial Educational Isolation Index (Bravo) of selected educational attainment category(ies).

Usage

```
bravo(
  geo = "tract",
  year = 2020,
  subgroup,
  crs = "ESRI:102008",
  quiet = FALSE,
  ...
)
```

Arguments

geo	Character string specifying the geography of the data either census tracts `geo = 'tract'` (the default) or counties `geo = 'county'`.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the educational attainment category(ies). See Details for available choices.
crs	Numeric or character string specifying the coordinate reference system to compute the distance-based metric. The default is Albers North America `crs = 'ESRI:102008'`.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to `get_acs` to select state, county, and other arguments for census characteristics

Details

This function will compute the spatial Educational Isolation Index (*EI*) of U.S. census tracts or counties for a specified geographical extent (e.g., the entire U.S. or a single state) based on Bravo et al. (2021) doi:10.3390/ijerph18179384 who originally designed the metric for the educational isolation of individual without a college degree. This function provides the computation of *EI* for any of the U.S. Census Bureau educational attainment levels.

The function uses the `get_acs` to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the geospatial computation. The yearly estimates are available for 2009 onward when ACS-5 data are available but are available from other U.S. Census Bureau surveys. The five educational attainment levels (U.S. Census Bureau definitions) are:

- **B06009_002**: Less than high school graduate `'LtHS'`
- **B06009_003**: High school graduate (includes equivalency) `'HSGiE'`
- **B06009_004**: Some college or associate's degree `'SCoAD'`
- **B06009_005**: Bachelor's degree `'BD'`
- **B06009_006**: Graduate or professional degree `'GoPD'`

Note: If `year = 2009`, then the ACS-5 data (2005-2009) are from the **B15002** question.

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output. NOTE: Current version does not correct for edge effects (e.g., census geographies along the specified spatial extent border, coastline, or U.S.-Mexico / U.S.-Canada border) may have few neighboring census geographies, and *EI* values in these census geographies may be unstable. A stop-gap solution for the former source of edge effect is to compute the *EI* for neighboring census geographies (i.e., the states bordering a study area of interest) and then use the estimates of the study area of interest.

A census geography (and its neighbors) that has nearly all of its population with the specified educational attainment category (e.g., a Bachelor's degree or more) will have an *EI* value close to 1. In contrast, a census geography (and its neighbors) that is nearly none of its population with the specified educational attainment category (e.g., less than a Bachelor's degree) will have an *EI* value close to 0.

Value

An object of class 'list'. This is a named list with the following components:

`ei` An object of class 'tbl' for the GEOID, name, *EI*, and raw census values of specified census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *EI*.

References

Bravo, MA, Leong, MC, Gelfand, AE, & Miranda, ML (2021) Assessing Disparity Using Measures of Racial and Educational Isolation. *International Journal of Environmental Research and Public Health*, 18(17):9384. doi:10.3390/ijerph18179384

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Racial Isolation Index: `anthopolos`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Educational Isolation Index (a measure of exposure)
  ## of less than some college or associate's degree attainment
  ## in census tracts of Georgia, U.S.A. (2020)
```

```
  bravo(
    geo = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = c('LtHS', 'HSGiE')
   )


## End(Not run)
```

DCtracts2020 *Formatted U.S. Census American Community Survey 5-year estimate data for DC census tracts (2020) from the 'tidycensus' package*

Description

A sample dataset containing information about U.S. Census American Community Survey 5-year estimate data for the District of Columbia census tracts (2020). The data are obtained from the `get_acs` function and formatted for the `messer` and `powell_wiley` functions input.

Usage

```
DCtracts2020
```

Format

A data frame with 206 rows and 23 variables:

GEOID census tract ID

TotalPop arcsinh-transformed CD3

OCC percent males in management, science, and arts occupation

CWD percent of crowded housing

POV percent of households in poverty

FHH percent of female headed households with dependents

PUB percent of households on public assistance

U30 percent of households earning <$30,000 per year

EDU percent earning less than a high school education

EMP percent unemployed

logMedHHInc median household income (dollars), natural log-transformed

PctNoIDRZ percent of households receiving dividends, interest, or rental income, Z-transformed

PctPubAsstZ percent of households receiving public assistance, Z-transformed

logMedHomeVal median home value (dollars), natural log-transformed

PctWorkClassZ percent in a management, business, science, or arts occupation, Z-transformed

PctFemHeadKidsZ percent of households that are female headed with any children under 18 years, Z-transformed

PctNotOwnerOccZ percent of housing units that are owner occupied, Z-transformed

PctNoPhoneZ percent of households without a telephone, Z-transformed

PctNComPlmbZ percent of households without complete plumbing facilities, Z-transformed

PctEducLTHSZ percent with a high school degree or higher (population 25 years and over), Z-transformed

PctEducLTBchZ percent with a college degree or higher (population 25 years and over), Z-transformed

PctFamBelowPovZ percent of families with incomes below the poverty level, Z-transformed

PctUnemplZ percent unemployed, Z-transformed

Source

https://github.com/idblr/ndi/blob/master/README.md

Examples

```
head(DCtracts2020)
```

---

denton *Relative Clustering based on Massey & Denton (1988)*

Description

Compute the aspatial Relative Clustering (Massey & Denton) of a selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
denton(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  subgroup_ref,
  crs = "ESRI:102008",
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties geo_large = 'county'.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts geo_small = 'tract'.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the racial or ethnic subgroup(s) as the comparison population. See Details for available choices.
subgroup_ref	Character string specifying the racial or ethnic subgroup(s) as the reference population. See Details for available choices.
crs	Numeric or character string specifying the coordinate reference system to compute the distance-based metric. The default is Albers North America crs = 'ESRI:102008'.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Relative Clustering (*RCL*) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Massey & Denton (1988) doi:10.1093/sf/67.2.281. This function provides the computation of *RCL* for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for geo_large = 'cbsa' and 2011 onward for geo_large = 'place', geo_large = 'csa', or geo_large = 'metro') but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino 'NHoL'
- **B03002_003**: not Hispanic or Latino, white alone 'NHoLW'
- **B03002_004**: not Hispanic or Latino, Black or African American alone 'NHoLB'
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone 'NHoLAIAN'
- **B03002_006**: not Hispanic or Latino, Asian alone 'NHoLA'
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone 'NHoLNHOPI'
- **B03002_008**: not Hispanic or Latino, Some other race alone 'NHoLSOR'
- **B03002_009**: not Hispanic or Latino, Two or more races 'NHoLTOMR'

- **B03002_010**: not Hispanic or Latino, Two races including Some other race `'NHoLTRiSOR'`
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

RCL is a measure of clustering of racial or ethnic populations within smaller geographical units that are located within larger geographical units. *RCL* can range in value from -Inf to Inf and represents the degree to which an area is a racial or ethnic enclave. *RCL* equals 0 when the racial or ethnic subgroup population displays the same amount of clustering as the referent racial or ethnic subgroup population, and is positive whenever the racial or ethnic subgroup population members display greater clustering than is typical of the the referent racial or ethnic subgroup population. If the racial or ethnic subgroup population members were less clustered than the the referent racial or ethnic subgroup population, then *RCL* would be negative.

The metric uses the exponential transform of a distance matrix (kilometers) between smaller geographical area centroids, with a diagonal defined as `(0.6*a_{i})^{0.5}` where `a_{i}` is the area (square kilometers) of smaller geographical unit `i` as defined by White (1983) doi:10.1086/227768.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *RCL* value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *V* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *RCL* computation.

Value

An object of class 'list'. This is a named list with the following components:

`rcl` An object of class 'tbl' for the GEOID, name, and *RCL* at specified larger census geographies.

`rcl_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *RCL*.

References

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Absolute Clustering: `massey`

Proximity measures: `morgan_massey`, `morgan_denton`, `white_blau`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Relative Clustering (a measure of clustering)
  ## of non-Hispanic Black vs. non-Hispanic white populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  denton(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = 'NHoLB',
    subgroup_ref = 'NHoLW'
   )


## End(Not run)
```

`denton_cuzzort` *Relative Concentration based on Massey & Denton (1988) and Duncan, Cuzzort, & Duncan (1961)*

Description

Compute the aspatial Relative Concentration (Massey & Denton) of a selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
denton_cuzzort(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  subgroup_ref,
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties geo_large = 'county'.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts geo_small = 'tract'.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the racial or ethnic subgroup(s) as the comparison population. See Details for available choices.
subgroup_ref	Character string specifying the racial or ethnic subgroup(s) as the reference population. See Details for available choices.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Relative Concentration (*RCO*) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Massey & Denton (1988) doi:10.1093/sf/67.2.281 and Duncan, Cuzzort, & Duncan (1961; LC:60007089). This function provides the computation of *RCO* for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for geo_large = 'cbsa' and 2011 onward for geo_large = 'place', geo_large = 'csa', or geo_large = 'metro') but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino 'NHoL'

- **B03002_003**: not Hispanic or Latino, white alone `'NHoLW'`
- **B03002_004**: not Hispanic or Latino, Black or African American alone `'NHoLB'`
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone `'NHoLAIAN'`
- **B03002_006**: not Hispanic or Latino, Asian alone `'NHoLA'`
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'NHoLNHOPI'`
- **B03002_008**: not Hispanic or Latino, Some other race alone `'NHoLSOR'`
- **B03002_009**: not Hispanic or Latino, Two or more races `'NHoLTOMR'`
- **B03002_010**: not Hispanic or Latino, Two races including Some other race `'NHoLTRiSOR'`
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

RCO is a measure of concentration of racial or ethnic populations within smaller geographical units that are located within larger geographical units. *RCO* is a measure of concentration of racial or ethnic populations within smaller geographical units that are located within larger geographical units. *RCO* can range from -1 to 1 and represents the share of a larger geographical unit occupied by a racial or ethnic subgroup compared to a referent racial or ethnic subgroup. A value of 1 indicates that the concentration of the racial or ethnic subgroup exceeds the concentration of the referent racial or ethnic subgroup at the maximum extent possible. A value of -1 is the converse. Note: Computed as designed, but values smaller than -1 are possible if the racial or ethnic subgroup population is larger than the referent racial or ethnic subgroup population.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *RCO* value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan

divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *V* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *RCO* computation.

Value

An object of class 'list'. This is a named list with the following components:

`rco` An object of class 'tbl' for the GEOID, name, and *RCO* at specified larger census geographies.

`rco_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *RCO*.

References

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

Duncan, OD, Cuzzort, RP, & Duncan, B (1961) *Statistical Geography: Problems in Analyzing Area Data*. Free Press. LC:60007089

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Absolute Concentration: `massey_duncan`

Delta: `hoover`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Relative Concentration (a measure of concentration)
  ## of non-Hispanic Black vs. non-Hispanic white populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  denton_cuzzort(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = 'NHoLB',
    subgroup_ref = 'NHoLW'
   )


## End(Not run)
```

duncan *Dissimilarity Index based on Duncan & Duncan (1955)*

Description

Compute the aspatial Dissimilarity Index (Duncan & Duncan) of selected racial or ethnic subgroup(s) and U.S. geographies

Usage

```
duncan(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  subgroup_ref,
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties geo_large = 'county'.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts geo_small = 'tract'.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the racial or ethnic subgroup(s) as the comparison population. See Details for available choices.
subgroup_ref	Character string specifying the racial or ethnic subgroup(s) as the reference population. See Details for available choices.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Dissimilarity Index (*D*) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single

state) based on Duncan & Duncan (1955) doi:10.2307/2088328. This function provides the computation of *D* for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the `get_acs` function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the aspatial computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for `geo_large = 'cbsa'` and 2011 onward for `geo_large = 'place'`, `geo_large = 'csa'`, or `geo_large = 'metro'`) but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino `'NHoL'`
- **B03002_003**: not Hispanic or Latino, white alone `'NHoLW'`
- **B03002_004**: not Hispanic or Latino, Black or African American alone `'NHoLB'`
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone `'NHoLAIAN'`
- **B03002_006**: not Hispanic or Latino, Asian alone `'NHoLA'`
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'NHoLNHOPI'`
- **B03002_008**: not Hispanic or Latino, Some other race alone `'NHoLSOR'`
- **B03002_009**: not Hispanic or Latino, Two or more races `'NHoLTOMR'`
- **B03002_010**: not Hispanic or Latino, Two races including Some other race `'NHoLTRiSOR'`
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

D is a measure of the evenness of racial or ethnic residential segregation when comparing smaller geographical units to larger ones within which the smaller geographical units are located. *D* can range in value from 0 to 1 and represents the proportion of racial or ethnic subgroup members that would have to change their area of residence to achieve an even distribution within the larger geographical area under conditions of maximum segregation.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`,

core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *D* value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *D* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *D* computation.

Value

An object of class 'list'. This is a named list with the following components:

`d` An object of class 'tbl' for the GEOID, name, and *D* at specified larger census geographies.

`d_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *D*.

References

Duncan, OD, & Duncan, B (1955) Residential Distribution and Occupational Stratification. *American Journal of Sociology*, 60(5):493-503. doi:10.2307/2088328

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

One-group evenness indices: `atkinson`, `gini`, `james_taeuber`, `sudano`, `theil`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Dissimilarity Index (Duncan & Duncan; a measure of evenness)
  ## of non-Hispanic Black vs. non-Hispanic white populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  duncan(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = 'NHoLB',
    subgroup_ref = 'NHoLW'
   )
```

```
## End(Not run)
```

---

duncan_cuzzort *Absolute Centralization based on Duncan, Cuzzort, & Duncan (1961) and Massey & Denton (1988)*

Description

Compute the aspatial Absolute Centralization (Duncan & Cuzzort) of a selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
duncan_cuzzort(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  crs = "ESRI:102008",
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties geo_large = 'county'.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts geo_small = 'tract'.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the racial or ethnic subgroup(s) as the comparison population. See Details for available choices.
crs	Numeric or character string specifying the coordinate reference system to compute the distance-based metric. The default is Albers North America crs = 'ESRI:102008'.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Absolute Centralization (*ACE*) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Duncan, Cuzzort, & Duncan (1961; LC:60007089) and Massey & Denton (1988) doi:10.1093/sf/67.2.281. This function provides the computation of *ACE* for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the `get_acs` function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for `geo_large = 'cbsa'` and 2011 onward for `geo_large = 'place'`, `geo_large = 'csa'`, or `geo_large = 'metro'`) but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino `'NHoL'`
- **B03002_003**: not Hispanic or Latino, white alone `'NHoLW'`
- **B03002_004**: not Hispanic or Latino, Black or African American alone `'NHoLB'`
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone `'NHoLAIAN'`
- **B03002_006**: not Hispanic or Latino, Asian alone `'NHoLA'`
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'NHoLNHOPI'`
- **B03002_008**: not Hispanic or Latino, Some other race alone `'NHoLSOR'`
- **B03002_009**: not Hispanic or Latino, Two or more races `'NHoLTOMR'`
- **B03002_010**: not Hispanic or Latino, Two races including Some other race `'NHoLTRiSOR'`
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

ACE is a measure of the degree to which racial or ethnic populations within smaller geographical units are located near the center of a larger geographical unit. *ACE* can range in value from -1 to 1 and represents the spatial distribution of racial or ethnic populations within smaller geographical

units compared to the distribution of land area around the center of a larger geographical unit. Positive values indicate a tendency for racial or ethnic populations to reside close to the center of a larger geographical unit, while negative values indicate a tendency to live in outlying areas. A score of 0 means that racial or ethnic populations have a uniform distribution throughout a larger geographical unit. *ACE* gives the proportion of racial or ethnic populations required to change residence to achieve a uniform distribution of population around the center of a larger geographical unit.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *ACE* value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *V* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *ACE* computation.

Important consideration: The original metric used the location of the central business district (CBD) to compute the metric, but the U.S. Census Bureau has not defined CBDs for U.S. cities since the 1982 Census of Retail Trade. Therefore, this function uses the the centroids of each larger geographical unit as the 'centre', but may not represent the current CBD.

Value

An object of class 'list'. This is a named list with the following components:

`ace` An object of class 'tbl' for the GEOID, name, and *ACE* at specified larger census geographies.

`ace_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *ACE*.

References

Duncan, OD, Cuzzort, RP, & Duncan, B (1961) *Statistical Geography: Problems in Analyzing Area Data*. Free Press. LC:60007089

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Relative Centralization: `duncan_duncan`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Absolute Centralization (a measure of centralization)
  ## of Black populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  duncan_cuzzort(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = c('NHoLB', 'HoLB')
   )


## End(Not run)
```

---

duncan_duncan *Relative Centralization based on Duncan, Cuzzort, & Duncan (1961) and Massey & Denton (1988)*

Description

Compute the aspatial Relative Centralization (Duncan & Duncan) of a selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
duncan_duncan(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  subgroup_ref,
  crs = "ESRI:102008",
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties geo_large = 'county'.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts geo_small = 'tract'.

year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the racial or ethnic subgroup(s) as the comparison population. See Details for available choices.
subgroup_ref	Character string specifying the racial or ethnic subgroup(s) as the reference population. See Details for available choices.
crs	Numeric or character string specifying the coordinate reference system to compute the distance-based metric. The default is Albers North America `crs = 'ESRI:102008'`.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to `get_acs` to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Relative Centralization (*RCE*) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Duncan & Duncan (1955) doi:10.1086/221609 and Massey & Denton (1988) doi:10.1093/sf/67.2.281. This function provides the computation of *RCE* for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the `get_acs` function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for `geo_large = 'cbsa'` and 2011 onward for `geo_large = 'place'`, `geo_large = 'csa'`, or `geo_large = 'metro'`) but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino `'NHoL'`
- **B03002_003**: not Hispanic or Latino, white alone `'NHoLW'`
- **B03002_004**: not Hispanic or Latino, Black or African American alone `'NHoLB'`
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone `'NHoLAIAN'`
- **B03002_006**: not Hispanic or Latino, Asian alone `'NHoLA'`
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'NHoLNHOPI'`
- **B03002_008**: not Hispanic or Latino, Some other race alone `'NHoLSOR'`
- **B03002_009**: not Hispanic or Latino, Two or more races `'NHoLTOMR'`
- **B03002_010**: not Hispanic or Latino, Two races including Some other race `'NHoLTRiSOR'`
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`

- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

RCE is a measure of the degree to which racial or ethnic populations within smaller geographical units are located near the center of a larger geographical unit. *RCE* can range in value from -1 to 1 and represents the spatial distribution of racial or ethnic populations within smaller geographical units relative to the compared to the distribution of the referent racial or ethnic population around the center of a larger geographical unit. Positive values indicate a tendency for racial or ethnic populations to reside closer to the center of a larger geographical unit than the referent racial or ethnic population, while negative values indicate the racial or ethnic population is distributed farther from the center of a larger geographical unit than the referent racial or ethnic population. A score of 0 means that racial or ethnic populations have a uniform distribution throughout a larger geographical unit. *RCE* gives the proportion of racial or ethnic populations required to change residence to match the degree of centralization of the referent racial or ethnic population.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *RCE* value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *V* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *RCE* computation.

Important consideration: The original metric used the location of the central business district (CBD) to compute the metric, but the U.S. Census Bureau has not defined CBDs for U.S. cities since the 1982 Census of Retail Trade. Therefore, this function uses the the centroids of each larger geographical unit as the 'centre', but may not represent the current CBD.

Value

An object of class 'list'. This is a named list with the following components:

`rce` An object of class 'tbl' for the GEOID, name, and *RCE* at specified larger census geographies.

`rce_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *RCE*.

References

Duncan, OD, Cuzzort, RP, & Duncan, B (1961) *Statistical Geography: Problems in Analyzing Area Data*. Free Press. LC:60007089

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Absolute Centralization: `duncan_cuzzort`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Relative Centralization (a measure of centralization)
  ## of non-Hispanic Black vs. non-Hispanic white populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  duncan_duncan(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = 'NHoLB',
    subgroup_ref = 'NHoLW'
   )


## End(Not run)
```

`gini` *Gini Index based on Gini (1921)*

Description

Compute the aspatial racial or ethnic Gini Index and retrieve the aspatial income Gini Index

Usage

```
gini(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties geo_large = 'county'.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts geo_small = 'tract'.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the racial or ethnic subgroup(s). See Details for available choices.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will retrieve the aspatial Gini Index (*G*) of U.S. census tracts or counties for a specified geographical extent (e.g., the entire U.S. or a single state) based on Gini (1921) doi:10.2307/2223319 for income inequality (at smaller geographical units) and race or ethnicity inequality (at larger geographical units).

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey estimates of *G* for the geospatial computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for geo_large = 'cbsa' and 2011 onward for geo_large = 'place', geo_large = 'csa', or geo_large = 'metro') but are available from other U.S. Census Bureau surveys. The function will retrieve the provided income inequality metric (**B19083**) and the twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino 'NHoL'
- **B03002_003**: not Hispanic or Latino, white alone'NHoLW'
- **B03002_004**: not Hispanic or Latino, Black or African American alone 'NHoLB'
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone 'NHoLAIAN'

- **B03002_006**: not Hispanic or Latino, Asian alone `'NHoLA'`
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'NHoLNHOPI'`
- **B03002_008**: not Hispanic or Latino, Some other race alone `'NHoLSOR'`
- **B03002_009**: not Hispanic or Latino, Two or more races `'NHoLTOMR'`
- **B03002_010**: not Hispanic or Latino, Two races including Some other race `'NHoLTRiSOR'`
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

According to the U.S. Census Bureau https://www.census.gov/topics/income-poverty/income-inequality/about/metrics/gini-index.html: 'The Gini Index is a summary measure of income inequality. The Gini coefficient incorporates the detailed shares data into a single statistic, which summarizes the dispersion of income across the entire income distribution. The Gini coefficient ranges from 0, indicating perfect equality (where everyone receives an equal share), to 1, perfect inequality (where only one recipient or group of recipients receives all the income). The Gini Index is based on the difference between the Lorenz curve (the observed cumulative income distribution) and the notion of a perfectly equal income distribution.' For racial or ethnic inequality, G is a summary measure of racial or ethnic unevenness or the mean absolute difference between a selected subgroup proportions weighted across all pairs of geographic units, expressed as a proportion of the maximum weighted difference.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the V value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the V computation (see internal `st_within` function for more

information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *V* computation.

Value

An object of class 'list'. This is a named list with the following components:

`g` An object of class 'tbl' for the GEOID, name, and *G_re* metrics of specified census geographies.

`g_data` An object of class 'tbl' for the raw census values at specified smaller census geographies including *G_inc*.

`missing` An object of class 'tbl' of the count and proportion of missingness for *G_inc* and each census variable used to compute *G_re*.

References

Gini, C (1921) Measurement of Inequality of Incomes. *The Economic Journal*, 31(121):124-126. doi:10.2307/2223319

Duncan, OD, & Duncan, B (1955) Residential Distribution and Occupational Stratification. *American Journal of Sociology*, 60(5):493-503. doi:10.2307/2088328

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Other one-group evenness indices: `atkinson`, `james_taeuber`, `sudano`, `theil`

Between groups dissimilarity indices: `duncan`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Gini Index (a metric of evenness)
  ## of Black populations
  ## in census tracts of Georgia, U.S.A. (2020)
  gini(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = c('NHoLB', 'HoLB')
   )


## End(Not run)
```

hoover *Delta based on Hoover (1941) and Duncan, Cuzzort, & Duncan (1961)*

Description

Compute the aspatial Delta (Hoover) of a selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
hoover(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties `geo_large = 'county'`.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts `geo_small = 'tract'`.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the racial or ethnic subgroup(s). See Details for available choices.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to `get_acs` to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Delta (*DEL*) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Hoover (1941) doi:10.1017/S0022050700052980 and Duncan, Cuzzort, and Duncan (1961; LC:60007089). This function provides the computation of *DEL* for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the aspatial computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for geo_large = 'cbsa' and 2011 onward for geo_large = 'place', geo_large = 'csa', or geo_large = 'metro') but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino 'NHoL'
- **B03002_003**: not Hispanic or Latino, white alone 'NHoLW'
- **B03002_004**: not Hispanic or Latino, Black or African American alone 'NHoLB'
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone 'NHoLAIAN'
- **B03002_006**: not Hispanic or Latino, Asian alone 'NHoLA'
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone 'NHoLNHOPI'
- **B03002_008**: not Hispanic or Latino, Some other race alone 'NHoLSOR'
- **B03002_009**: not Hispanic or Latino, Two or more races 'NHoLTOMR'
- **B03002_010**: not Hispanic or Latino, Two races including Some other race 'NHoLTRiSOR'
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races 'NHoLTReSOR'
- **B03002_012**: Hispanic or Latino 'HoL'
- **B03002_013**: Hispanic or Latino, white alone 'HoLW'
- **B03002_014**: Hispanic or Latino, Black or African American alone 'HoLB'
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone 'HoLAIAN'
- **B03002_016**: Hispanic or Latino, Asian alone 'HoLA'
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone 'HoLNHOPI'
- **B03002_018**: Hispanic or Latino, Some other race alone 'HoLSOR'
- **B03002_019**: Hispanic or Latino, Two or more races 'HoLTOMR'
- **B03002_020**: Hispanic or Latino, Two races including Some other race 'HoLTRiSOR'
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races 'HoLTReSOR'

Use the internal state and county arguments within the get_acs function to specify geographic extent of the data output.

DEL is a measure of the proportion of members of one subgroup(s) residing in geographic units with above average density of members of the subgroup(s). The index provides the proportion of a subgroup population that would have to move across geographic units to achieve a uniform density. *DEL* can range in value from 0 to 1.

Larger geographical units available include states geo_large = 'state', counties geo_large = 'county', census tracts geo_large = 'tract', census-designated places geo_large = 'place', core-based statistical areas geo_large = 'cbsa', combined statistical areas geo_large = 'csa', and metropolitan divisions geo_large = 'metro'. Smaller geographical units available include, counties geo_small = 'county', census tracts geo_small = 'tract', and census block groups geo_small = 'cbg'. If a larger geographical unit is comprised of only one smaller geographical

unit (e.g., a U.S county contains only one census tract), then the *DEL* value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *DEL* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *DEL* computation.

Value

An object of class 'list'. This is a named list with the following components:

`del` An object of class 'tbl' for the GEOID, name, and *DEL* at specified larger census geographies.

`del_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *DEL*.

References

Hoover, EM (1941) Interstate Redistribution of Population, 1850-1940. *Journal of Economic History*, 1:199-205. doi:10.2307/2223319

Duncan, OD, Cuzzort, RP, & Duncan, B (1961) *Statistical Geography: Problems in Analyzing Area Data*. Free Press. LC:60007089

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Absolute Concentration: `massey_duncan`

Relative Concentration: `denton_cuzzort`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Delta (a measure of concentration)
  ## of non-Hispanic Black populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  hoover(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = 'NHoLB'
   )
```

```
## End(Not run)
```

`james_taeuber` *Dissimilarity Index based on James & Taeuber (1985)*

Description

Compute the aspatial Dissimilarity Index (James & Taeuber) of selected racial or ethnic subgroup(s) and U.S. geographies

Usage

```
james_taeuber(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

`geo_large`	Character string specifying the larger geographical unit of the data. The default is counties `geo_large = 'county'`.
`geo_small`	Character string specifying the smaller geographical unit of the data. The default is census tracts `geo_small = 'tract'`.
`year`	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
`subgroup`	Character string specifying the racial or ethnic subgroup(s) as the comparison population. See Details for available choices.
`omit_NAs`	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
`quiet`	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
`...`	Arguments passed to `get_acs` to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Dissimilarity Index (*D*) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on James & Taeuber (1985) doi:10.2307/270845. This function provides the computation of *D* for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the `get_acs` function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the aspatial computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for `geo_large = 'cbsa'` and 2011 onward for `geo_large = 'place'`, `geo_large = 'csa'`, or `geo_large = 'metro'`) but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino `'NHoL'`
- **B03002_003**: not Hispanic or Latino, white alone `'NHoLW'`
- **B03002_004**: not Hispanic or Latino, Black or African American alone `'NHoLB'`
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone `'NHoLAIAN'`
- **B03002_006**: not Hispanic or Latino, Asian alone `'NHoLA'`
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'NHoLNHOPI'`
- **B03002_008**: not Hispanic or Latino, Some other race alone `'NHoLSOR'`
- **B03002_009**: not Hispanic or Latino, Two or more races `'NHoLTOMR'`
- **B03002_010**: not Hispanic or Latino, Two races including Some other race `'NHoLTRiSOR'`
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

D is a measure of the evenness of racial or ethnic residential segregation when comparing smaller geographical units to larger ones within which the smaller geographical units are located. *D* can range in value from 0 to 1 and represents the proportion of racial or ethnic subgroup members

that would have to change their area of residence to achieve an even distribution within the larger geographical area under conditions of maximum segregation.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *D* value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *D* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *D* computation.

Value

An object of class 'list'. This is a named list with the following components:

`d` An object of class 'tbl' for the GEOID, name, and *D* at specified larger census geographies.

`d_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *D*.

References

James, D, & Taeuber, KE (1985) Measures of Segregation. *Sociological Methodology*, 15:1-32. doi:10.2307/270845

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Other one-group evenness indices: `atkinson`, `gini`, `sudano`, `theil`

Between groups dissimilarity indices: `duncan`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Dissimilarity Index (James & Taeuber; a measure of evenness)
  ## of Black populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  james_taeuber(
```

```
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = c('NHoLB', 'HoLB')
   )


## End(Not run)
```

`krieger` *Index of Concentration at the Extremes based on Feldman et al. (2015) and Krieger et al. (2016)*

Description

Compute the aspatial Index of Concentration at the Extremes (Krieger).

Usage

```
krieger(geo = "tract", year = 2020, quiet = FALSE, ...)
```

Arguments

`geo`	Character string specifying the geography of the data either census tracts `geo = 'tract'` (the default) or counties `geo = 'county'`.
`year`	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
`quiet`	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
`...`	Arguments passed to `get_acs` to select state, county, and other arguments for census characteristics

Details

This function will compute three aspatial Index of Concentration at the Extremes (*ICE*) of U.S. census tracts or counties for a specified geographical extent (e.g., entire U.S. or a single state) based on Feldman et al. (2015) doi:10.1136/jech2015205728 and Krieger et al. (2016) doi:10.2105/AJPH.2015.302955. The authors expanded the metric designed by Massey in a chapter of Booth & Crouter (2001) doi:10.4324/9781410600141 who initially designed the metric for residential segregation. This function computes five *ICE* metrics:

- **Income**: 80th income percentile vs. 20th income percentile
- **Education**: less than high school vs. four-year college degree or more
- **Race or Ethnicity**: white non-Hispanic vs. black non-Hispanic

- **Income and race or ethnicity combined**: white non-Hispanic in 80th income percentile vs. black alone (including Hispanic) in 20th income percentile
- **Income and race or ethnicity combined**: white non-Hispanic in 80th income percentile vs. white non-Hispanic in 20th income percentile

The function uses the `get_acs` function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the geospatial computation. The yearly estimates are available for 2009 onward when ACS-5 data are available but are available from other U.S. Census Bureau surveys. The ACS-5 groups used in the computation of the five *ICE* metrics are:

- **B03002**: HISPANIC OR LATINO ORIGIN BY RACE
- **B15002**: SEX BY EDUCATIONAL ATTAINMENT FOR THE POPULATION 25 YEARS AND OVER
- **B19001**: HOUSEHOLD INCOME IN THE PAST 12 MONTHS (IN 20XX INFLATION-ADJUSTED DOLLARS)
- **B19001B**: HOUSEHOLD INCOME IN THE PAST 12 MONTHS (IN 20XX INFLATION-ADJUSTED DOLLARS) (BLACK OR AFRICAN AMERICAN ALONE HOUSEHOLDER)
- **B19001H**: HOUSEHOLD INCOME IN THE PAST 12 MONTHS (IN 20XX INFLATION-ADJUSTED DOLLARS) (WHITE ALONE, NOT HISPANIC OR LATINO HOUSEHOLDER)

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

ICE metrics can range in value from -1 (most deprived) to 1 (most privileged). A value of 0 can thus represent two possibilities: (1) none of the residents are in the most privileged or most deprived categories, or (2) an equal number of persons are in the most privileged and most deprived categories, and in both cases indicates that the area is not dominated by extreme concentrations of either of the two groups.

Value

An object of class 'list'. This is a named list with the following components:

`ice` An object of class 'tbl' for the GEOID, name, *ICE* metrics, and raw census values of specified census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute the *ICE* metrics.

References

Feldman, JM, Waterman, PD, Coull, BA, & Krieger, N (2015) Spatial Social Polarisation: Using the Index of Concentration at the Extremes Jointly for Income and Race/Ethnicity to Analyse Risk of Hypertension. *Journal of Epidemiology and Community Health*, 69(12):1199-207. doi:10.1136/jech2015205728

Waterman, PD, Spasojevic, J, Li, W, Maduro, G, & Wye, GV (2016) Public Health Monitoring of Privilege and Deprivation With the Index of Concentration at the Extremes. *American Journal of Public Health*, 106(2):256-263. doi:10.2105/AJPH.2015.302955

See Also

get_acs for additional arguments for geographic extent selection (i.e., state and county).

Other concentration metrics: denton_cuzzort, hoover, massey_duncan

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Tract-level metrics (2020)
  krieger(geo = 'tract', state = 'GA', year = 2020)

  # County-level metrics (2020)
  krieger(geo = 'county', state = 'GA', year = 2020)


## End(Not run)
```

---

lieberson *Isolation Index based on Lieberson (1981) and Bell (1954)*

Description

Compute the aspatial Isolation Index (Lieberson) of a selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
lieberson(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties geo_large = 'county'.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts geo_small = 'tract'.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.

subgroup	Character string specifying the racial or ethnic subgroup(s). See Details for available choices.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Isolation Index (*xPx**) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Lieberson (1981; ISBN-13:978-1-032-53884-6) and Bell (1954) doi:10.2307/2574118. This function provides the computation of *xPx** for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the aspatial computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for geo_large = 'cbsa' and 2011 onward for geo_large = 'place', geo_large = 'csa', or geo_large = 'metro') but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino 'NHoL'
- **B03002_003**: not Hispanic or Latino, white alone 'NHoLW'
- **B03002_004**: not Hispanic or Latino, Black or African American alone 'NHoLB'
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone 'NHoLAIAN'
- **B03002_006**: not Hispanic or Latino, Asian alone 'NHoLA'
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone 'NHoLNHOPI'
- **B03002_008**: not Hispanic or Latino, Some other race alone 'NHoLSOR'
- **B03002_009**: not Hispanic or Latino, Two or more races 'NHoLTOMR'
- **B03002_010**: not Hispanic or Latino, Two races including Some other race 'NHoLTRiSOR'
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races 'NHoLTReSOR'
- **B03002_012**: Hispanic or Latino 'HoL'
- **B03002_013**: Hispanic or Latino, white alone 'HoLW'
- **B03002_014**: Hispanic or Latino, Black or African American alone 'HoLB'
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone 'HoLAIAN'
- **B03002_016**: Hispanic or Latino, Asian alone 'HoLA'
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone 'HoLNHOPI'
- **B03002_018**: Hispanic or Latino, Some other race alone 'HoLSOR'
- **B03002_019**: Hispanic or Latino, Two or more races 'HoLTOMR'

- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

*xPx** is some measure of the probability that a member of one subgroup(s) will meet or interact with a member of their subgroup(s) with higher values signifying higher probability of interaction (less isolation). *xPx** can range in value from 0 to 1.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *xPx** value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *xPx** computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *xPx** computation.

Value

An object of class 'list'. This is a named list with the following components:

`xpx_star` An object of class 'tbl' for the GEOID, name, and *xPx** at specified larger census geographies.

`xpx_star_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *xPx**.

References

Lieberson, S (1981). "An Asymmetrical Approach to Segregation." Pp. 61-82 in *Ethnic Segregation in Cities*, edited by Peach, C, Robinson, V, & Smith, S. 1st Ed. London:Croom Helm. ISBN-13:978-1-032-53884-6

Bell, W (1954) A probability model for the measurement of ecological segregation. *Social Forces*, 32(4):357-364. doi:10.2307/2574118

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

See Also

get_acs for additional arguments for geographic extent selection (i.e., state and county).

Other isolation indices: anthopolos, bemanian_beyer, morgan_massey, white

Interaction indices: bell, morgan_denton

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Interaction (a measure of exposure)
  ## of non-Hispanic Black vs. non-Hispanic white populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  bell(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = 'NHoLB'
   )


## End(Not run)
```

---

massey *Absolute Clustering based on Massey & Denton (1988)*

Description

Compute the aspatial Absolute Clustering (Massey & Denton) of a selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
massey(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  crs = "ESRI:102008",
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties geo_large = 'county'.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts geo_small = 'tract'.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the racial or ethnic subgroup(s) as the comparison population. See Details for available choices.
crs	Numeric or character string specifying the coordinate reference system to compute the distance-based metric. The default is Albers North America crs = 'ESRI:102008'.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Absolute Clustering (*ACL*) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Massey & Denton (1988) doi:10.1093/sf/67.2.281. This function provides the computation of *ACL* for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for geo_large = 'cbsa' and 2011 onward for geo_large = 'place', geo_large = 'csa', or geo_large = 'metro') but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino 'NHoL'
- **B03002_003**: not Hispanic or Latino, white alone 'NHoLW'
- **B03002_004**: not Hispanic or Latino, Black or African American alone 'NHoLB'
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone 'NHoLAIAN'
- **B03002_006**: not Hispanic or Latino, Asian alone 'NHoLA'
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone 'NHoLNHOPI'
- **B03002_008**: not Hispanic or Latino, Some other race alone 'NHoLSOR'
- **B03002_009**: not Hispanic or Latino, Two or more races 'NHoLTOMR'
- **B03002_010**: not Hispanic or Latino, Two races including Some other race 'NHoLTRiSOR'

- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

ACL is a measure of clustering of racial or ethnic populations within smaller geographical units that are located within larger geographical units. *ACL* can range in value from 0 to Inf and represents the degree to which an area is a racial or ethnic enclave. A value of 1 indicates there is no differential clustering of the racial or ethnic subgroup. A value greater than 1 indicates the racial or ethnic subgroup live nearer to one another. A value less than 1 indicates the racial or ethnic subgroup do not live near one another.

The metric uses the exponential transform of a distance matrix (kilometers) between smaller geographical area centroids, with a diagonal defined as `(0.6*a_{i})^{0.5}` where `a_{i}` is the area (square kilometers) of smaller geographical unit `i` as defined by White (1983) doi:10.1086/227768.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *ACL* value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *V* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *ACL* computation.

Value

An object of class 'list'. This is a named list with the following components:

`acl` An object of class 'tbl' for the GEOID, name, and *ACL* at specified larger census geographies.

`acl_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *ACL*.

References

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Relative Clustering Index: `denton`

Proximity measures: `morgan_denton`, `morgan_massey`, `white_blau`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Absolute Clustering (a measure of clustering)
  ## of Black populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  massey(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = c('NHoLB', 'HoLB')
   )


## End(Not run)
```

`massey_duncan` *Absolute Concentration based on Massey & Denton (1988) and Duncan, Cuzzort, & Duncan (1961)*

Description

Compute the aspatial Absolute Concentration (Massey & Denton) of a selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
massey_duncan(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties geo_large = 'county'.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts geo_small = 'tract'.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the racial or ethnic subgroup(s) as the comparison population. See Details for available choices.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Absolute Concentration (*ACO*) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Massey & Denton (1988) doi:10.1093/sf/67.2.281 and Duncan, Cuzzort, & Duncan (1961; LC:60007089). This function provides the computation of *ACO* for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for geo_large = 'cbsa' and 2011 onward for geo_large = 'place', geo_large = 'csa', or geo_large = 'metro') but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino 'NHoL'
- **B03002_003**: not Hispanic or Latino, white alone 'NHoLW'
- **B03002_004**: not Hispanic or Latino, Black or African American alone 'NHoLB'
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone 'NHoLAIAN'

- **B03002_006**: not Hispanic or Latino, Asian alone `'NHoLA'`
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'NHoLNHOPI'`
- **B03002_008**: not Hispanic or Latino, Some other race alone `'NHoLSOR'`
- **B03002_009**: not Hispanic or Latino, Two or more races `'NHoLTOMR'`
- **B03002_010**: not Hispanic or Latino, Two races including Some other race `'NHoLTRiSOR'`
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

ACO is a measure of concentration of racial or ethnic populations within smaller geographical units that are located within larger geographical units. *ACO* can range from 0 to 1 and represents the relative amount of physical space occupied by a racial or ethnic subgroup in a larger geographical unit. A value of 1 indicates that a racial or ethnic subgroup has achieved the maximum spatial concentration possible (all racial or ethnic subgroup members live in the smallest of the smaller geographical units). A value of 0 indicates the maximum deconcentration possible (all racial or ethnic subgroup members live in the largest of the smaller geographical units).

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *ACO* value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *V* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *ACO* computation.

Value

An object of class 'list'. This is a named list with the following components:

`aco` An object of class 'tbl' for the GEOID, name, and *ACO* at specified larger census geographies.

`aco_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *ACO*.

References

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

Duncan, OD, Cuzzort, RP, & Duncan, B (1961) *Statistical Geography: Problems in Analyzing Area Data*. Free Press. LC:60007089

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Relative Concentration: `denton_cuzzort`

Delta: `hoover`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Absolute Concentration (a measure of concentration)
  ## of Black populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  massey_duncan(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = c('NHoLB', 'HoLB')
   )


## End(Not run)
```

messer *Neighborhood Deprivation Index based on Messer et al. (2006)*

Description

Compute the aspatial Neighborhood Deprivation Index (Messer).

Usage

```
messer(
  geo = "tract",
  year = 2020,
  imp = FALSE,
  quiet = FALSE,
  round_output = FALSE,
  df = NULL,
  ...
)
```

Arguments

geo	Character string specifying the geography of the data either census tracts geo = 'tract' (the default) or counties geo = 'county'.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2010 onward are currently available.
imp	Logical. If TRUE, will impute missing census characteristics within the internal principal. If FALSE (the default), will not impute.
quiet	Logical. If TRUE, will display messages about potential missing census information and the proportion of variance explained by principal component analysis. The default is FALSE.
round_output	Logical. If TRUE, will round the output of raw census and *NDI* values from the get_acs at one and four significant digits, respectively. The default is FALSE.
df	Optional. Pass a pre-formatted 'dataframe' or 'tibble' with the desired variables through the function. Bypasses the data obtained by get_acs. The default is NULL. See Details below.
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Neighborhood Deprivation Index (*NDI*) of U.S. census tracts or counties for a specified geographical referent (e.g., US-standardized) based on Messer et al. (2006) doi:10.1007/s115240069094x.

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for computation involving a principal component analysis with the

principal function. The yearly estimates are available for 2010 and after when all census characteristics became available. The eight characteristics are:

- **OCC (C24030)**: percent males in management, science, and arts occupation
- **CWD (B25014)**: percent of crowded housing
- **POV (B17017)**: percent of households in poverty
- **FHH (B25115)**: percent of female headed households with dependents
- **PUB (B19058)**: percent of households on public assistance
- **U30 (B19001)**: percent of households earning <$30,000 per year
- **EDU (B06009)**: percent earning less than a high school education
- **EMP (B23025)**: percent unemployed (2011 onward)
- **EMP (B23001)**: percent unemployed (2010 only)

Use the internal state and county arguments within the get_acs function to specify the referent for standardizing the *NDI* (Messer) values. For example, if all U.S. states are specified for the state argument, then the output would be a U.S.-standardized index.

The continuous *NDI* (Messer) values are z-transformed, i.e., 'standardized,' and the categorical *NDI* (Messer) values are quartiles of the standardized continuous *NDI* (Messer) values.

Check if the proportion of variance explained by the first principal component is high (more than 0.5).

Users can bypass get_acs by specifying a pre-formatted data frame or tibble using the df argument. This function will compute an index using the first component of a principal component analysis (PCA) with a Varimax rotation (the default for principal) and only one factor (note: PCA set-up not unspecified in Messer et al. (2006)). The recommended structure of the data frame or tibble is an ID (e.g., GEOID) in the first feature (column), followed by the variables of interest (in any order) and no additional information (e.g., omit state or county names from the df argument input).

Value

An object of class 'list'. This is a named list with the following components:

ndi An object of class 'tbl' for the GEOID, name, *NDI* (standardized), *NDI* (quartile), and raw census values of specified census geographies.

pca An object of class 'principal', returns the output of principal used to compute the *NDI* values.

missing An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *NDI*.

References

Messer, LC, Laraia, BA, Kaufman, JS, Eyster, J, Holzman, C, Culhane, J, Elo, I, Burke, J, O'Campo, P (2006) The Development of a Standardized Neighborhood Deprivation Index. *Journal of Urban Health*, 83(6):1041-1062. doi:10.1007/s115240069094x

See Also

get_acs for additional arguments for geographic referent selection (i.e., state and county).

Neighborhood Deprivation Index: powell_wiley

Examples

```
messer(df = DCtracts2020[ , c(1, 3:10)])

## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Tract-level NDI (Messer; 2020)
  messer(geo = 'tract', state = 'GA', year = 2020)

  # Impute NDI (Messer; 2020) for tracts with missing census information (median values)
  messer(state = 'tract', state = 'GA', year = 2020, imp = TRUE)


## End(Not run)
```

---

morgan_denton *Distance-Decay Interaction Index based on Morgan (1983) and Massey & Denton (1988)*

Description

Compute the aspatial Distance-Decay Interaction Index (Morgan) of a selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
morgan_denton(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  subgroup_ixn,
  crs = "ESRI:102008",
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties geo_large = 'county'.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts geo_small = 'tract'.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.

subgroup	Character string specifying the racial or ethnic subgroup(s) as the comparison population. See Details for available choices.
subgroup_ixn	Character string specifying the racial or ethnic subgroup(s) as the interaction population. If the same as subgroup, will compute the simple isolation of the group. See Details for available choices.
crs	Numeric or character string specifying the coordinate reference system to compute the distance-based metric. The default is Albers North America crs = 'ESRI:102008'.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Distance-Decay Interaction Index (*DPxy**) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Morgan (1986) https://www.jstor.org/stable/20001935 and Massey & Denton (1988) doi:10.1093/sf/67.2.281. This function provides the computation of *DPxy** for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for geo_large = 'cbsa' and 2011 onward for geo_large = 'place', geo_large = 'csa', or geo_large = 'metro') but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino 'NHoL'
- **B03002_003**: not Hispanic or Latino, white alone 'NHoLW'
- **B03002_004**: not Hispanic or Latino, Black or African American alone 'NHoLB'
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone 'NHoLAIAN'
- **B03002_006**: not Hispanic or Latino, Asian alone 'NHoLA'
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone 'NHoLNHOPI'
- **B03002_008**: not Hispanic or Latino, Some other race alone 'NHoLSOR'
- **B03002_009**: not Hispanic or Latino, Two or more races 'NHoLTOMR'
- **B03002_010**: not Hispanic or Latino, Two races including Some other race 'NHoLTRiSOR'
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races 'NHoLTReSOR'
- **B03002_012**: Hispanic or Latino 'HoL'
- **B03002_013**: Hispanic or Latino, white alone 'HoLW'

- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

*DPxy** is a measure of clustering of racial or ethnic populations within smaller geographical units that are located within larger geographical units. *DPxy** is some measure of the probability that a member of a racial or ethnic subgroup will meet or interact with a member of another racial or ethnic subgroup(s). *DPxy** can range in value from 0 to 1 with higher values signifying higher probability of interaction.

The metric uses the exponential transform of a distance matrix (kilometers) between smaller geographical area centroids, with a diagonal defined as `(0.6*a_{i})^{0.5}` where `a_{i}` is the area (square kilometers) of smaller geographical unit `i` as defined by White (1983) doi:10.1086/227768.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *DPxy** value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *V* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *DPxy** computation.

Value

An object of class 'list'. This is a named list with the following components:

`dpxy_star` An object of class 'tbl' for the GEOID, name, and *DPxy** at specified larger census geographies.

`dpxy_star_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *DPxy**.

References

Morgan, BS (1983) A Distance-Decay Based Interaction Index to Measure Residential Segregation. *Area*, 15(3):211-217. https://www.jstor.org/stable/20001935

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

See Also

get_acs for additional arguments for geographic extent selection (i.e., state and county).

Other proximity measures: morgan_massey, white_blau

Other interaction indices: bell

Isolation indices: anthopolos, bemanian_beyer, lieberson, morgan_massey, white

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Distance-Decay Interaction Index (a measure of clustering)
  ## of non-Hispanic Black vs. non-Hispanic white populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  morgan_denton(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = 'NHoLB',
    subgroup_ixn = 'NHoLW'
   )


## End(Not run)
```

---

morgan_massey *Distance-Decay Isolation Index based on Morgan (1983) and Massey & Denton (1988)*

Description

Compute the aspatial Distance-Decay Isolation Index (Morgan) of a selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
morgan_massey(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  crs = "ESRI:102008",
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties geo_large = 'county'.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts geo_small = 'tract'.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the racial or ethnic subgroup(s) as the comparison population. See Details for available choices.
crs	Numeric or character string specifying the coordinate reference system to compute the distance-based metric. The default is Albers North America crs = 'ESRI:102008'.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Distance-Decay Isolation Index (*DPxx**) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Morgan (1986) https://www.jstor.org/stable/20001935 and Massey & Denton (1988) doi:10.1093/sf/67.2.281. This function provides the computation of *DPxx** for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for geo_large = 'cbsa' and 2011 onward for geo_large = 'place', geo_large = 'csa', or geo_large = 'metro') but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino `'NHoL'`
- **B03002_003**: not Hispanic or Latino, white alone `'NHoLW'`
- **B03002_004**: not Hispanic or Latino, Black or African American alone `'NHoLB'`
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone `'NHoLAIAN'`
- **B03002_006**: not Hispanic or Latino, Asian alone `'NHoLA'`
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'NHoLNHOPI'`
- **B03002_008**: not Hispanic or Latino, Some other race alone `'NHoLSOR'`
- **B03002_009**: not Hispanic or Latino, Two or more races `'NHoLTOMR'`
- **B03002_010**: not Hispanic or Latino, Two races including Some other race `'NHoLTRiSOR'`
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

*DPxx** is a measure of clustering of racial or ethnic populations within smaller geographical units that are located within larger geographical units. *DPxx** is some measure of the probability that a member of one racial or ethnic subgroup will meet or interact with a member of the same racial or ethnic subgroup. *DPxx** can range in value from 0 to 1 with higher values signifying higher probability of isolation (less isolation).

The metric uses the exponential transform of a distance matrix (kilometers) between smaller geographical area centroids, with a diagonal defined as `(0.6*a_{i})^{0.5}` where `a_{i}` is the area (square kilometers) of smaller geographical unit `i` as defined by White (1983) doi:10.1086/227768.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *DPxx** value returned is NA.

If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *V* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *DPxx** computation.

Value

An object of class 'list'. This is a named list with the following components:

`dpxx_star` An object of class 'tbl' for the GEOID, name, and *DPxx** at specified larger census geographies.

`dpxx_star_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *DPxx**.

References

Morgan, BS (1983) A Distance-Decay Based Interaction Index to Measure Residential Segregation. *Area*, 15(3):211-217. https://www.jstor.org/stable/20001935

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Other proximity measures: `morgan_denton`, `white_blau`

Other isolation indices: `anthopolos`, `bemanian_beyer`, `lieberson`, `white`

Interaction indices: `bell`, `morgan_denton`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Distance-Decay Isolation Index (a measure of clustering)
  ## of Black populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  morgan_massey(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = c('NHoLB', 'HoLB')
   )
```

```
## End(Not run)
```

`powell_wiley` *Neighborhood Deprivation Index based on Andrews et al. (2020) and Slotman et al. (2022)*

Description

Compute the aspatial Neighborhood Deprivation Index (Powell-Wiley).

Usage

```
powell_wiley(
  geo = "tract",
  year = 2020,
  imp = FALSE,
  quiet = FALSE,
  round_output = FALSE,
  df = NULL,
  ...
)
```

Arguments

`geo`	Character string specifying the geography of the data either census tracts `geo = 'tract'` (the default) or counties `geo = 'county'`.
`year`	Numeric. The year to compute the estimate. The default is 2020, and the years 2010 onward are currently available.
`imp`	Logical. If TRUE, will impute missing census characteristics within the internal `principal` using median values of variables. If FALSE (the default), will not impute.
`quiet`	Logical. If TRUE, will display messages about potential missing census information, standardized Cronbach's alpha, and proportion of variance explained by principal component analysis. The default is FALSE.
`round_output`	Logical. If TRUE, will round the output of raw census and *NDI* values from the `get_acs` at one and four significant digits, respectively. The default is FALSE.
`df`	Optional. Pass a pre-formatted `'dataframe'` or `'tibble'` with the desired variables through the function. Bypasses the data obtained by `get_acs`. The default is NULL. See Details below.
`...`	Arguments passed to `get_acs` to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Neighborhood Deprivation Index (*NDI*) of U.S. census tracts or counties for a specified geographical referent (e.g., US-standardized) based on Andrews et al. (2020) doi:10.1080/17445647.2020.1750066 and Slotman et al. (2022) doi:10.1016/j.dib.2022.108002.

The function uses the `get_acs` function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for computation involving a factor analysis with the `principal` function. The yearly estimates are available in 2010 and after when all census characteristics became available. The thirteen characteristics chosen by Roux and Mair (2010) doi:10.1111/j.1749-6632.2009.05333.x are:

- **MedHHInc (B19013)**: median household income (dollars)
- **PctRecvIDR (B19054)**: percent of households receiving dividends, interest, or rental income
- **PctPubAsst (B19058)**: percent of households receiving public assistance
- **MedHomeVal (B25077)**: median home value (dollars)
- **PctMgmtBusScArti (C24060)**: percent in a management, business, science, or arts occupation
- **PctFemHeadKids (B11005)**: percent of households that are female headed with any children under 18 years
- **PctOwnerOcc (DP04)**: percent of housing units that are owner occupied
- **PctNoPhone (DP04)**: percent of households without a telephone
- **PctNComPlm (DP04)**: percent of households without complete plumbing facilities
- **PctEducHSPlus (S1501)**: percent with a high school degree or higher (population 25 years and over)
- **PctEducBchPlus (S1501)**: percent with a college degree or higher (population 25 years and over)
- **PctFamBelowPov (S1702)**: percent of families with incomes below the poverty level
- **PctUnempl (S2301)**: percent unemployed

Use the internal `state` and `county` arguments within the `get_acs` function to specify the referent for standardizing the *NDI* (Powell-Wiley) values. For example, if all U.S. states are specified for the `state` argument, then the output would be a U.S.-standardized index. Please note: the *NDI* (Powell-Wiley) values will not exactly match (but will highly correlate with) those found in Andrews et al. (2020) doi:10.1080/17445647.2020.1750066 and Slotman et al. (2022) doi:10.1016/j.dib.2022.108002 because the two studies used a different statistical platform (i.e., SPSS and SAS, respectively) that intrinsically calculate the principal component analysis differently from R.

The categorical *NDI* (Powell-Wiley) values are population-weighted quintiles of the continuous *NDI* (Powell-Wiley) values. NOTE: As of version 0.2.0, population-weighted quintiles are computed using a weighted quantile function `wtd.quantile` where values are calculated NDI and weights are Total Population instead of previously using `quantile` of the product of the calculated NDI and natural logarithm transformed total population.

Check if the proportion of variance explained by the first principal component is high (more than 0.5).

Users can bypass `get_acs` by specifying a pre-formatted data frame or tibble using the `df` argument. This function will compute an index using the first component of a principal component analysis

(PCA) with a Promax (oblique) rotation and a minimum Eigenvalue of 1, omitting variables with absolute loading score < 0.4. The recommended structure of the data frame or tibble is an ID (e.g., GEOID) in the first feature (column), an estimate of the total population in the second feature (column), followed by the variables of interest (in any order) and no additional information (e.g., omit state or county names from the `df` argument input).

Value

An object of class 'list'. This is a named list with the following components:

`ndi` An object of class 'tbl' for the GEOID, name, *NDI* continuous, *NDI* quintiles, and raw census values of specified census geographies.

`pca` An object of class 'principal', returns the output of `principal` used to compute the *NDI* values.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *NDI*.

`cronbach` An object of class 'character' or 'numeric' for the results of the Cronbach's alpha calculation. If only one factor is computed, a message is returned. If more than one factor is computed, Cronbach's alpha is calculated and should check that it is >0.7 for respectable internal consistency between factors.

References

Andrews, MA, Tomura, K, Claudel, SE, Xu, S, Ceasar, JN, Collins, BS, Langerman, S, Mitchell, VM, Baumer, Y, & Powell-Wiley TM (2020) Geospatial Analysis of Neighborhood Deprivation Index (NDI) for the United States by County. *Journal of Maps*, 16(1):101-112. doi:10.1080/17445647.2020.1750066

Slotman, BA, Stinchcomb, DG, Powell-Wiley, TM, Ostendorf, DM, Saelens, BE, Gorin, AA, Zenk, SN, & Berrigan, D (2022) Environmental Data and Methods from the Accumulating Data to Optimally Predict Obesity Treatment (ADOPT) Core Measures Environmental Working Group. *Data in Brief*, 41:108002. doi:10.1016/j.dib.2022.108002

See Also

`get_acs` for additional arguments for geographic referent selection (i.e., `state` and `county`).

Neighborhood Deprivation Index: `messer`

Examples

```
powell_wiley(df = DCtracts2020[ , -c(3:10)])

## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Tract-level NDI (Powell-Wiley; 2020)
  powell_wiley(geo = 'tract', state = 'GA', year = 2020)

 # Impute NDI (Powell-Wiley; 2020) for tracts with missing census information (median values)
  powell_wiley(state = 'tract', state = 'GA', year = 2020, imp = TRUE)
```

```
## End(Not run)
```

---

sudano *Location Quotient based on Merton (1938) and Sudano et al. (2013)*

Description

Compute the aspatial Location Quotient (Sudano) of a selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
sudano(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

`geo_large`	Character string specifying the larger geographical unit of the data. The default is counties `geo_large = 'county'`.
`geo_small`	Character string specifying the smaller geographical unit of the data. The default is census tracts `geo_small = 'tract'`.
`year`	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
`subgroup`	Character string specifying the racial or ethnic subgroup(s). See Details for available choices.
`omit_NAs`	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
`quiet`	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
`...`	Arguments passed to `get_acs` to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Location Quotient (*LQ*) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Merton (1939) doi:10.2307/2084686 and Sudano et al. (2013) doi:10.1016/j.healthplace.2012.09.015. This function provides the computation of *LQ* for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the `get_acs` function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the aspatial computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for `geo_large = 'cbsa'` and 2011 onward for `geo_large = 'place'`, `geo_large = 'csa'`, or `geo_large = 'metro'`) but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino `'NHoL'`
- **B03002_003**: not Hispanic or Latino, white alone `'NHoLW'`
- **B03002_004**: not Hispanic or Latino, Black or African American alone `'NHoLB'`
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone `'NHoLAIAN'`
- **B03002_006**: not Hispanic or Latino, Asian alone `'NHoLA'`
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'NHoLNHOPI'`
- **B03002_008**: not Hispanic or Latino, Some other race alone `'NHoLSOR'`
- **B03002_009**: not Hispanic or Latino, Two or more races `'NHoLTOMR'`
- **B03002_010**: not Hispanic or Latino, Two races including Some other race `'NHoLTRiSOR'`
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

LQ is some measure of relative racial homogeneity of each smaller geographical units within a larger geographical unit. *LQ* can range in value from 0 to infinity because it is ratio of two proportions in which the numerator is the proportion of subgroup population in a smaller geographical unit and the

denominator is the proportion of subgroup population in its larger geographical unit. For example, a smaller geographical unit with an *LQ* of 5 means that the proportion of the subgroup population living in the smaller geographical unit is five times the proportion of the subgroup population in its larger geographical unit.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *LQ* value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *LQ* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *LQ* computation.

Value

An object of class 'list'. This is a named list with the following components:

`lq` An object of class 'tbl' for the GEOID, name, and *LQ* at specified smaller census geographies.

`lq_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *LQ*.

References

Merton, RK (1938) Social Structure and Anomie. *American Sociological Review*, 3(5):672-682. doi:10.2307/2084686

Sudano, JJ, Perzynski, A, Wong, DW, Colabianchi, N, Litaker, D (2013) Neighborhood Racial Residential Segregation and Changes in Health or Death Among Older Adults. *Health & Place*, 19:80-88. doi:10.1016/j.healthplace.2012.09.015

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Other one-group evenness indices: `atkinson`, `gini`, `james_taeuber`, `theil`

Between groups dissimilarity indices: `duncan`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Location Quotient (a measure of relative homogeneity)
```

```
  ## of Black populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  sudano(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = c('NHoLB', 'HoLB')
   )


## End(Not run)
```

`theil` *Entropy based on Theil (1972) and Theil & Finizza (1971)*

Description

Compute the aspatial Entropy (Theil) of selected racial or ethnic subgroup(s) and U.S. geographies

Usage

```
theil(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

`geo_large`	Character string specifying the larger geographical unit of the data. The default is counties `geo_large = 'county'`.
`geo_small`	Character string specifying the smaller geographical unit of the data. The default is census tracts `geo_small = 'tract'`.
`year`	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
`subgroup`	Character string specifying the racial or ethnic subgroup(s) as the comparison population. See Details for available choices.
`omit_NAs`	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
`quiet`	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.

... Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Entropy (*H*) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Theil (1972; ISBN-13:978-0-444-10378-9) and Theil & Finizza (1971) doi:10.1080/0022250X.1971.9989795. This function provides the computation of *H* for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the aspatial computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for `geo_large = 'cbsa'` and 2011 onward for `geo_large = 'place'`, `geo_large = 'csa'`, or `geo_large = 'metro'`) but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino `'NHoL'`
- **B03002_003**: not Hispanic or Latino, white alone `'NHoLW'`
- **B03002_004**: not Hispanic or Latino, Black or African American alone `'NHoLB'`
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone `'NHoLAIAN'`
- **B03002_006**: not Hispanic or Latino, Asian alone `'NHoLA'`
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'NHoLNHOPI'`
- **B03002_008**: not Hispanic or Latino, Some other race alone `'NHoLSOR'`
- **B03002_009**: not Hispanic or Latino, Two or more races `'NHoLTOMR'`
- **B03002_010**: not Hispanic or Latino, Two races including Some other race `'NHoLTRiSOR'`
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

H is a measure of the evenness of racial or ethnic residential segregation when comparing smaller geographical units to larger ones within which the smaller geographical units are located. *H* can range in value from 0 to 1 and represents the (weighted) average deviation of each smaller geographical unit from the larger geographical unit's "entropy" or racial and ethnic diversity, which is greatest when each group is equally represented in the larger geographical unit. *H* varies between 0, when all smaller geographical units have the same racial or ethnic composition as the larger geographical area (i.e., maximum integration), to a high of 1, when all smaller geographical units contain one group only (maximum segregation).

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *H* value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *H* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *H* computation.

Note: The computation differs from Massey & Denton (1988) doi:10.1093/sf/67.2.281 by taking the absolute value of `(E-E_{i})` so extent of the output is `{0, 1}` as designed by Theil (1972; ISBN-13:978-0-444-10378-9) instead of `{-Inf, Inf}` as described in Massey & Denton (1988) doi:10.1093/sf/67.2.281.

Value

An object of class 'list'. This is a named list with the following components:

`h` An object of class 'tbl' for the GEOID, name, and *H* at specified larger census geographies.

`h_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *H*.

References

Theil, H (1972) *Statistical decomposition analysis: with applications in the social and administrative*. Amsterdam: North-Holland Publishing Company. ISBN-13:978-1-032-53884-6

Theil, H, & Finizza, AJ (1971) A Note on the Measurement of Racial Integration of Schools by Means of Informational Concepts. *Journal of Mathematical Sociology*, 1:187-194. doi:10.1080/0022250X.1971.9989795

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

See Also

get_acs for additional arguments for geographic extent selection (i.e., state and county).

Other one-group evenness indices: atkinson, gini, james_taeuber, sudano

Between groups dissimilarity indices: duncan

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Entropy (a measure of evenness)
  ## of Black populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  theil(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = c('NHoLB', 'HoLB')
   )


## End(Not run)
```

---

white *Correlation Ratio based on Bell (1954) and White (1986)*

Description

Compute the aspatial Correlation Ratio (White) of a selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
white(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties geo_large = 'county'.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts geo_small = 'tract'.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the racial or ethnic subgroup(s). See Details for available choices.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute the aspatial Correlation Ratio (V or Eta^2) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on Bell (1954) doi:10.2307/2574118 and White (1986) doi:10.2307/3644339. This function provides the computation of V for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the aspatial computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for geo_large = 'cbsa' and 2011 onward for geo_large = 'place', geo_large = 'csa', or geo_large = 'metro') but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino 'NHoL'
- **B03002_003**: not Hispanic or Latino, white alone 'NHoLW'
- **B03002_004**: not Hispanic or Latino, Black or African American alone 'NHoLB'
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone 'NHoLAIAN'
- **B03002_006**: not Hispanic or Latino, Asian alone 'NHoLA'
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone 'NHoLNHOPI'
- **B03002_008**: not Hispanic or Latino, Some other race alone 'NHoLSOR'
- **B03002_009**: not Hispanic or Latino, Two or more races 'NHoLTOMR'
- **B03002_010**: not Hispanic or Latino, Two races including Some other race 'NHoLTRiSOR'
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races 'NHoLTReSOR'
- **B03002_012**: Hispanic or Latino 'HoL'

- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

V removes the asymmetry from the Isolation Index (Bell) by controlling for the effect of population composition. The Isolation Index (Bell) is some measure of the probability that a member of one subgroup(s) will meet or interact with a member of another subgroup(s) with higher values signifying higher probability of interaction (less isolation). *V* can range in value from 0 to Inf.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *V* value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *V* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *V* computation.

Value

An object of class 'list'. This is a named list with the following components:

`v` An object of class 'tbl' for the GEOID, name, and *V* at specified larger census geographies.

`v_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *V*.

References

Bell, W (1954) A probability model for the measurement of ecological segregation. *Social Forces*, 32(4):357-364. doi:10.2307/2574118

White, MJ (1986) Segregation and Diversity Measures in Population Distribution. *Population Index*, 52(2):198-221. doi:10.2307/3644339

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Other isolation indices: `anthopolos`, `bemanian_beyer`, `lieberson`, `morgan_massey`

Interaction indices: `bell`, `morgan_denton`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Correlation Ratio (a measure of exposure)
  ## of Black populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  white(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = c('NHoLB', 'HoLB')
   )


## End(Not run)
```

`white_blau` *An index of spatial proximity based on White (1986) and Blau (1977)*

Description

Compute an index of spatial proximity (White) of a selected racial or ethnic subgroup(s) and U.S. geographies.

Usage

```
white_blau(
  geo_large = "county",
  geo_small = "tract",
  year = 2020,
  subgroup,
  subgroup_ref,
  crs = "ESRI:102008",
```

```
  omit_NAs = TRUE,
  quiet = FALSE,
  ...
)
```

Arguments

geo_large	Character string specifying the larger geographical unit of the data. The default is counties geo_large = 'county'.
geo_small	Character string specifying the smaller geographical unit of the data. The default is census tracts geo_small = 'tract'.
year	Numeric. The year to compute the estimate. The default is 2020, and the years 2009 onward are currently available.
subgroup	Character string specifying the racial or ethnic subgroup(s) as the comparison population. See Details for available choices.
subgroup_ref	Character string specifying the racial or ethnic subgroup(s) as the reference population. See Details for available choices.
crs	Numeric or character string specifying the coordinate reference system to compute the distance-based metric. The default is Albers North America crs = 'ESRI:102008'.
omit_NAs	Logical. If FALSE, will compute index for a larger geographical unit only if all of its smaller geographical units have values. The default is TRUE.
quiet	Logical. If TRUE, will display messages about potential missing census information. The default is FALSE.
...	Arguments passed to get_acs to select state, county, and other arguments for census characteristics

Details

This function will compute an index of spatial proximity (*SP*) of selected racial or ethnic subgroups and U.S. geographies for a specified geographical extent (e.g., the entire U.S. or a single state) based on White (1986) doi:10.2307/3644339 and Blau (1977; ISBN-13:978-0-029-03660-0). This function provides the computation of *SP* for any of the U.S. Census Bureau race or ethnicity subgroups (including Hispanic and non-Hispanic individuals).

The function uses the get_acs function to obtain U.S. Census Bureau 5-year American Community Survey characteristics used for the computation. The yearly estimates are available for 2009 onward when ACS-5 data are available (2010 onward for geo_large = 'cbsa' and 2011 onward for geo_large = 'place', geo_large = 'csa', or geo_large = 'metro') but may be available from other U.S. Census Bureau surveys. The twenty racial or ethnic subgroups (U.S. Census Bureau definitions) are:

- **B03002_002**: not Hispanic or Latino 'NHoL'
- **B03002_003**: not Hispanic or Latino, white alone 'NHoLW'
- **B03002_004**: not Hispanic or Latino, Black or African American alone 'NHoLB'
- **B03002_005**: not Hispanic or Latino, American Indian and Alaska Native alone 'NHoLAIAN'

- **B03002_006**: not Hispanic or Latino, Asian alone `'NHoLA'`
- **B03002_007**: not Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'NHoLNHOPI'`
- **B03002_008**: not Hispanic or Latino, Some other race alone `'NHoLSOR'`
- **B03002_009**: not Hispanic or Latino, Two or more races `'NHoLTOMR'`
- **B03002_010**: not Hispanic or Latino, Two races including Some other race `'NHoLTRiSOR'`
- **B03002_011**: not Hispanic or Latino, Two races excluding Some other race, and three or more races `'NHoLTReSOR'`
- **B03002_012**: Hispanic or Latino `'HoL'`
- **B03002_013**: Hispanic or Latino, white alone `'HoLW'`
- **B03002_014**: Hispanic or Latino, Black or African American alone `'HoLB'`
- **B03002_015**: Hispanic or Latino, American Indian and Alaska Native alone `'HoLAIAN'`
- **B03002_016**: Hispanic or Latino, Asian alone `'HoLA'`
- **B03002_017**: Hispanic or Latino, Native Hawaiian and Other Pacific Islander alone `'HoLNHOPI'`
- **B03002_018**: Hispanic or Latino, Some other race alone `'HoLSOR'`
- **B03002_019**: Hispanic or Latino, Two or more races `'HoLTOMR'`
- **B03002_020**: Hispanic or Latino, Two races including Some other race `'HoLTRiSOR'`
- **B03002_021**: Hispanic or Latino, Two races excluding Some other race, and three or more races `'HoLTReSOR'`

Use the internal `state` and `county` arguments within the `get_acs` function to specify geographic extent of the data output.

SP is a measure of clustering of racial or ethnic populations within smaller geographical units that are located within larger geographical units. *SP* can range in value from 0 to Inf and represents the degree to which an area is a racial or ethnic enclave. A value of 1 indicates there is no differential clustering between subgroup and referent group members. A value greater than 1 indicates subgroup members live nearer to one another than to referent subgroup members. A value less than 1 indicates subgroup live nearer to and referent subgroup members than to their own subgroup members.

The metric uses the exponential transform of a distance matrix (kilometers) between smaller geographical area centroids, with a diagonal defined as `(0.6*a_{i})^{0.5}` where `a_{i}` is the area (square kilometers) of smaller geographical unit `i` as defined by White (1983) doi:10.1086/227768.

Larger geographical units available include states `geo_large = 'state'`, counties `geo_large = 'county'`, census tracts `geo_large = 'tract'`, census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, and metropolitan divisions `geo_large = 'metro'`. Smaller geographical units available include, counties `geo_small = 'county'`, census tracts `geo_small = 'tract'`, and census block groups `geo_small = 'cbg'`. If a larger geographical unit is comprised of only one smaller geographical unit (e.g., a U.S county contains only one census tract), then the *SP* value returned is NA. If the larger geographical unit is census-designated places `geo_large = 'place'`, core-based statistical areas `geo_large = 'cbsa'`, combined statistical areas `geo_large = 'csa'`, or metropolitan divisions `geo_large = 'metro'`, only the smaller geographical units completely within a larger geographical unit are considered in the *V* computation (see internal `st_within` function for more information) and recommend specifying all states within which the interested larger geographical unit are located using the internal `state` argument to ensure all appropriate smaller geographical units are included in the *SP* computation.

Value

An object of class 'list'. This is a named list with the following components:

`sp` An object of class 'tbl' for the GEOID, name, and *SP* at specified larger census geographies.

`sp_data` An object of class 'tbl' for the raw census values at specified smaller census geographies.

`missing` An object of class 'tbl' of the count and proportion of missingness for each census variable used to compute *SP*.

References

White, MJ (1986) Segregation and Diversity Measures in Population Distribution. *Population Index*, 52(2):198-221. doi:10.2307/3644339

Blau, PM (1977) *Inequality and Heterogeneity: A Primitive Theory of Social Structure*. Free Press. ISBN-13:978-0-029-03660-0

Massey, DS, & Denton, NA (1988) The Dimensions of Residential Segregation. *Social Forces*, 67(1):281-315. doi:10.1093/sf/67.2.281

See Also

`get_acs` for additional arguments for geographic extent selection (i.e., `state` and `county`).

Other proximity measures: `morgan_denton`, `morgan_massey`

Relative Clustering: `denton`

Absolute Clustering: `massey`

Examples

```
## Not run:
# Wrapped in \dontrun{} because these examples require a Census API key.

  # Index of spatial proximity (a measure of clustering)
  ## of non-Hispanic Black vs. non-Hispanic white populations
  ## in census tracts within counties of Georgia, U.S.A. (2020)
  white_blau(
    geo_large = 'county',
    geo_small = 'tract',
    state = 'GA',
    year = 2020,
    subgroup = 'NHoLB',
    subgroup_ref = 'NHoLW'
   )


## End(Not run)
```

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